International Baccalaureate

International Baccalaureate

Asia Pacific

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Run by

Asia Pacific

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Mission Statement

The International Baccalaureate Organization aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

To this end the IBO works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.

These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

November 2002

La Déclaration de Mission de L'IBO

L'Organisation du Baccalauréat International (IBO) a pour but de développer chez les jeunes la curiosité intellectuelle, les connaissances et la sensibilité nécessaires pour contribuer à bâtir un monde meilleur et plus paisible, dans un esprit d'entente mutuelle et de respect interculturel.

À cette fin, l'IBO collabore avec des établissements scolaires, des gouvernements et des organisations internationales pour mettre au point des programmes d'éducation internationale stimulants et des méthodes d'évaluation rigoureuses.

Ces programmes encouragent les élèves de tout pays à apprendre activement tout au long de leur vie, à être empreints de compassion, et à comprendre que les autres, en étant différents, puissent aussi être dans le vrai.

Novembre 2002

Declaración de Principos de IBO

La Organización del Bachillerato Internacional tiene como meta formar jóvenes solidarios, informados y ávidos de conocimiento, capaces de contribuir a crear un mundo mejor y más pacífico, en el marco del entendimiento mutuo y el respeto intercultural.

En pos de este objetivo, la Organización del Bachillerato Internacional colabora con establecimientos escolares, gobiernos y organizaciones internacionales para crear y desarrollar programas de educación internacional exigentes y métodos de evaluación rigurosos.

Estos programas alientan a estudiantes del mundo entero a adoptar una actitud activa de aprendizaje durante toda su vida, a ser compasivos y a entender que otras personas, con sus diferencias, también pueden estar en lo cierto.

Noviembre 2002

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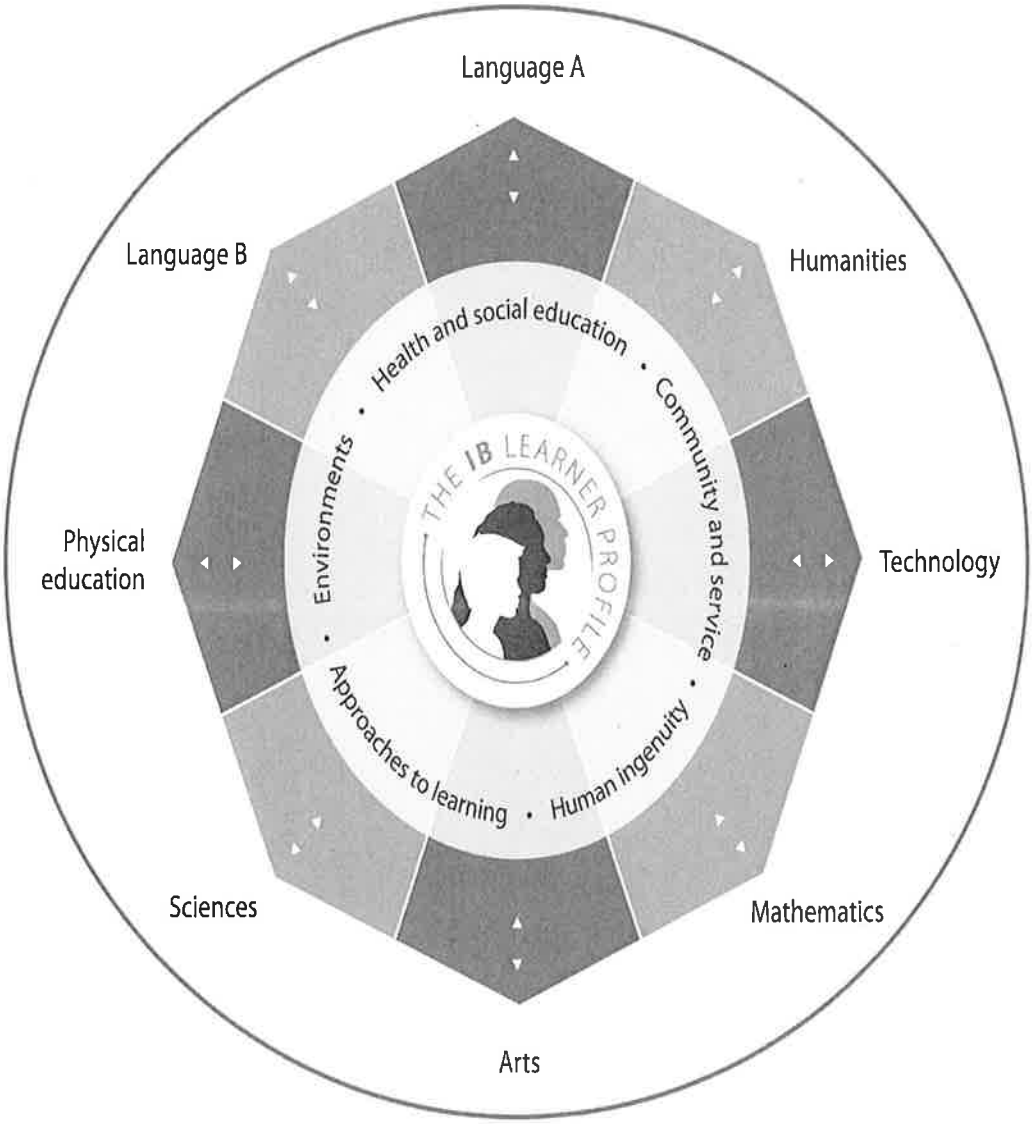


MYP Curriculum Model

NOTES:

The IB mission statement

> The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.
>
> To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.
>
> These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

In IB programmes, the attempt to define international-mindedness in increasingly clear terms, and the struggle to move closer to that ideal in practice, are central to the mission of IB World Schools. Given the variety of IB World Schools, and the complexity of the concept of international-mindedness, the IB has focused on the kind of student we hope will graduate from an IB World School, the kind of student who, in the struggle to establish a personal set of values and a code of ethics, will be laying the foundation upon which international-mindedness will develop and flourish. The attributes of such a learner are listed in the IB learner profile. The IB learner profile is the mission statement in action; it is central to the IB definition of what it means to be internationally minded, and it directs schools to focus on learning. IB World Schools should be proud to send out into the world students who exemplify the attributes expressed in this profile.

The IB learner profile is based on values that are the embodiment of what the organization believes about international education. The attributes described in the learner profile are appropriate to and achievable by all IB students from the ages of 3 to 19. The teacher needs to interpret these attributes in a manner appropriate to the age and development of the student, always bearing in mind that part of the adaptability and versatility of IB programmes lies in what these attributes may look like from one school culture to another.

In IB programmes it is both recognized and appreciated that students come from various backgrounds and bring with them a wealth of experience. All teachers have a responsibility to help students develop as lifelong learners in the context of the learner profile.

The mission statement and the learner profile are at the heart of the IB programme continuum.

IBO Mission Statement Reflection

IBO Mission Statement	How are we doing this now?	How can we do it better?
…aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world…		
…works with schools, governments and international organizations to develop challenging programmes and rigorous assessment.		
…encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.		

Questions to consider:
What are the key words or phrases that could potentially be a challenge to my school?

How might these be overcome?

What is the good news about this mission and the already existing mission at my school?

The MYP fundamental concepts

Holistic Learning - emphasizes the links between the disciplines, providing a global view of situations and issues. Students should become more aware of the relevance of their learning, and come to see knowledge as an interrelated whole. Students should see the cohesion and the complementarity of various fields of study, but this must not be done to the detriment of learning within each of the disciplines, which retain their own objectives and methodology.

What does this mean?

- Learning across the subject areas in your school is interrelated (cross-curricular links.)
- Learning takes on a greater meaning than simply the passing on of information. It becomes relevant to the student.
- Students become more aware of the impact of issues, actions and experience on a global level.

Intercultural Awareness - is concerned with developing the students' attitudes, knowledge and skills as they learn about their own and others' social and national cultures. By encouraging students to consider multi perspectives, intercultural awareness not only fosters tolerance and respect, but may also lead to empathy.

What does this mean?

- Students will learn about different cultures within their own country and in countries around the world.
- Students will learn to appreciate the value of the similarities and differences between societies and cultures around the world.
- Students through this scope of learning will hopefully develop a long lasting tolerance, respect and empathy toward their fellow humans.

Communication - is fundamental to learning, as it supports inquiry and understanding, and allows student reflection and expression. The MYP places particular emphasis on language acquisition and allows students to explore multiple forms of expression.

What does this mean?

- Students will be encouraged to develop communication skills in all areas of learning.
- Students will learn the value of self expression and learn to appreciate the importance of listening to others.
- Students will learn to reflect on all aspects of their learning through the different mechanisms of communication.

International® Baccalaureate

Frequently asked questions

1. *Why are the fundamental concepts not on the programme model?*

The fundamental concepts do not appear on the programme model, as they are the basis for the whole programme. Workshop leaders can access a wide array of alternative models or metaphors that do include the fundamental concepts, for example, a house. The bricks can be seen as the programme itself, the windows the area of interaction, and foundations of the house the fundamental concepts.

2. *Is it possible to consider intercultural awareness as "the 6th area of interaction"?*

No, many (implementing) schools are tempted to have intercultural awareness as the "6th area of interaction". Often there are very superficial links made to "internationalism", without meaningful reflection from within the school. Intercultural awareness goes beyond the areas of interaction as it should permeate the school all the time, rather than being an occasional "lens" for instruction. Intercultural awareness needs to affect all aspects of school life, from staff recruitment and choice of library books to teaching students mediation and conflict resolution skills.

3. *What is the link between the fundamental concepts and the areas of interaction?*

Teaching through the areas of interaction should help to promote the fundamental concepts. Both the fundamental concepts and the areas of interaction are unique characteristics of the programme and although they ultimately serve a common purpose they have different but interconnected roles.

While the fundamental concepts are essential components that underpin the whole philosophy of the programme, they also act as guiding principles for curriculum design and teaching planning. The areas of interaction on the other hand will provide the means for developing connections across the subject groups, fostering interdisciplinary teaching and allowing a variety of approaches for teaching and learning. The fundamental concepts will provide the rationale and the areas of interaction the active instruments for action.

Through the contexts for learning provided by the MYP's **areas of interaction**, students can come to realize that most real-world problems require insights gained from a variety of disciplines. Students develop skills of inquiry and come to understand the similarities and differences between different approaches to human knowledge. The framework allows students to apply disciplinary knowledge to different contexts. The areas of interaction serve to emphasize the relationships between the subject groups and provide a global view of situations and issues.

Teaching through the areas of interaction should help to promote the fundamental concepts. For example, schools can organize activities that reflect global issues related to the areas of interaction, such as a model United Nations or fundraising for an international NGO. The fundamental concepts can also provide a global perspective on issues connected to the areas of interaction.

4. *Does holistic learning mean teaching interdisciplinary topics?*

No, holistic learning means helping students understand interrelations between knowledge and subjects. This can be done through separate subject teaching provided teachers are aware of what their colleagues are teaching and help students make connections.

Whereas traditional curriculum frameworks have usually described the curriculum in terms of a body of knowledge only, the MYP views the curriculum as meeting the needs of the whole person. This other aspect of holistic learning is exemplified in the provision of objectives not just for knowledge alone. The MYP places great emphasis on:

- the understanding of concepts
- the mastery of skills
- the development of attitudes that can lead to considered and appropriate action.

Through acknowledging and attempting to meet the diverse needs of the student—physical, social, intellectual, aesthetic and cultural—schools ensure that learning in the MYP is significant, provocative, relevant, engaging and challenging.

5. *Should students be aware of the fundamental concepts?*

Yes, the IB is completely open about the structure of its programmes with students. Learning about the goals of the curriculum they participate in is part of the learning process.

6. *Do we assess the fundamental concepts?*

No, awareness of the fundamental concepts should be manifest in work students produce in the subject areas and in the personal project.

7. *Can you do a unit of work or exam on the fundamental concepts?*

Although it is possible to use the fundamental concepts as a theme or topic, teachers must remember that those concepts are primarily the basis of the whole programme, and should permeate all areas of the curriculum anyway.

8. *Should we base our MYP curriculum around the themes of the author JA Beane?*

No, the IB does not prescribe themes or topics. It is up to the schools and teachers to decide. On the other hand, Beane does give good examples of broad concepts and the IB uses his work as an example of good practice. The work from Lyn Erikson also provides interesting stimulus with regards to conceptual work.

The IB learner profile

IB learner profile	
The aim of all IB programmes is to develop internationally minded people who, recognizing our common humanity and shared guardianship of the planet, help to create a better and more peaceful world. IB learners strive to be:	
Inquirers	They develop their natural curiosity. They acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives.
Knowledgeable	They explore concepts, ideas and issues that have local and global significance. In so doing, they acquire in-depth knowledge and develop understanding across a broad and balanced range of disciplines.
Thinkers	They exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions.
Communicators	They understand and express ideas and information confidently and creatively in more than one language and in a variety of modes of communication. They work effectively and willingly in collaboration with others.
Principled	They act with integrity and honesty, with a strong sense of fairness, justice and respect for the dignity of the individual, groups and communities. They take responsibility for their own actions and the consequences that accompany them.
Open-minded	They understand and appreciate their own cultures and personal histories, and are open to the perspectives, values and traditions of other individuals and communities. They are accustomed to seeking and evaluating a range of points of view, and are willing to grow from the experience.
Caring	They show empathy, compassion and respect towards the needs and feelings of others. They have a personal commitment to service, and act to make a positive difference to the lives of others and to the environment.
Risk-takers	They approach unfamiliar situations and uncertainty with courage and forethought, and have the independence of spirit to explore new roles, ideas and strategies. They are brave and articulate in defending their beliefs.
Balanced	They understand the importance of intellectual, physical and emotional balance to achieve personal well-being for themselves and others.
Reflective	They give thoughtful consideration to their own learning and experience. They are able to assess and understand their strengths and limitations in order to support their learning and personal development.

The learner profile directs schools to focus on the development of the whole person. Developing an international perspective is a critical element of, and is central to, the programme; it must begin with encouraging each student to consider the point of view of someone else in the same class. By sharing experiences in the classroom setting and beyond, students can develop their awareness of, and sensitivity to, the experiences of others beyond the local or national community.

Are You an IB Learner?

IB Learners are:

Inquirers

- ☑ Are you curious?
- ☑ Do you know how to find answers to your questions?

Knowledgeable

- ☑ Do you know about a range of subjects and topics?

Thinkers

- ☑ Do you apply what you learn to new situations?
- ☑ Can you use your knowledge to solve problems and make good decisions?

Communicators

- ☑ Can you communicate your ideas clearly and in writing?
- ☑ Can you communicate in more than one language?
- ☑ Can you communicate using technology, art, music, and drama?

Principled

- ☑ Are you honest and fair to others?
- ☑ Do you respect the dignity of others?
- ☑ Do you take responsibility for your own actions and any consequences?

Open minded

- ☑ Do you appreciate your own culture?
- ☑ Are you open to other perspectives?

Caring

- ☑ Do you show compassion and empathy for the needs and feelings of others?
- ☑ Do you act to make a positive difference for others and for the environment?

Risk-Takers

- ☑ Do you approach unfamiliar situations with confidence?
- ☑ Do you share and defend your beliefs, even if you're not part of the majority?

Balanced

- ☑ Do you balance your intellectual, physical, and emotional needs?

Reflective

- ☑ Do you know your strengths and limitations?
- ☑ Do you look for ways to improve?

What type of IB learner am I?

For each of the specific IB learner profile traits, rate yourself using the following scale:

4 very much so 3 somewhat 2 very little 1 not at all

Inquirer

I am curious. _____
I know how to find answers to questions. _____
I enjoy learning about new things. _____

Knowledgeable

I know about a range of ideas and issues that have local significance. _____
I explore ideas and issues that have a global impact. _____
I understand the subjects I study in school are connected to the world we live in. ___

Thinker

I apply what I learn to new situations. _____
I use my knowledge to solve complex problems. _____
I think carefully before making decisions. _____

Communicator

I am comfortable and confident talking and writing about my ideas and I am able to do this in more than one language. _____
I am creative and able to express my ideas in many ways using different forms of art and technology. _____
I listen to others and express my ideas clearly in a group . _____

Principled

I have strong values. I am honest and fair. _____
I treat others with respect. _____
I take responsibilities for my actions and any consequences. _____

Open-minded

I understand, participate in and value my culture and history. _____
I appreciate and try to understand the values and traditions of other cultures. _____
I take other points of view into consideration before making up my mind. _____

Caring

I show compassion and respect towards the needs and feelings of others. _____
My daily actions make a positive difference for others and the environment. _____
I enjoy doing community and service. _____

Risk-taker

I approach unfamiliar situations with confidence. _____
I share and defend my beliefs. _____
I participate in many activities, seek new challenges and explore different ideas on a regular bases. ____

Balanced

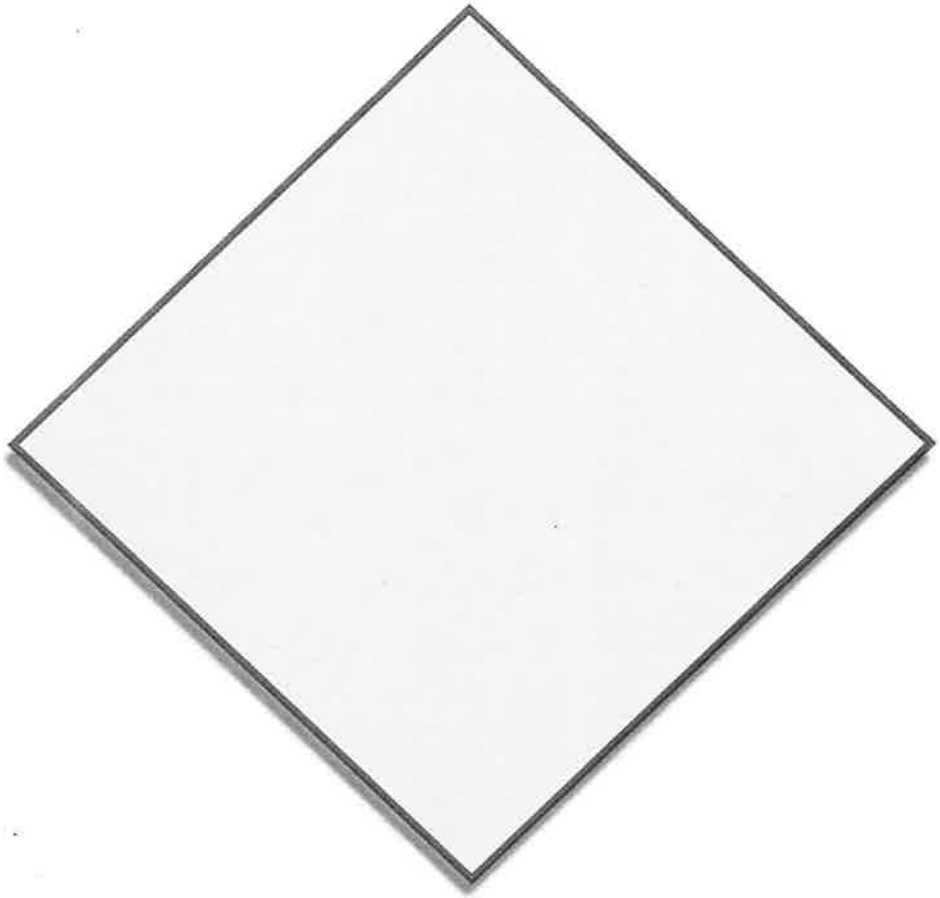
I am sociable and get along well with others. _____
I challenge myself. I love to learn new things and I am physically active. _____
I consider myself well-rounded. _____

Reflective

I know my strengths and weaknesses. _____
I think about ways to improve myself. _____
After completing a task, I take the time to review how I could have achieved a better result. ____

Year __ Date: _____

Instructions: Add up the totals for each characteristic and rank them by writing and placing each in the diamond. Strengths should be placed at the top, while characteristics that need work should be a placed at the bottom.



The IB learner profile is a map of a lifelong journey in pursuit of international-mindedness and intellectual, personal, emotional and social growth. What are your strengths and how will you improve your weaknesses?

Reflect and comment on your development as a lifelong learner.

_____
_____
_____
_____
_____

NASA Exercise: Survival on the Moon

Scenario:

You are a member of a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. However, due to mechanical difficulties, your ship was forced to land at a spot some 200 miles from the rendezvous point. During reentry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200-mile trip. Below are listed the 15 items left intact and undamaged after landing. Your task is to rank order them in terms of their importance for your crew in allowing them to reach the rendezvous point. Place the number **1** by the most important item, the number **2** by the second most important, and so on through number **15** for the least important.

Your Ranking **NASA Ranking**

_____ Box of matches _____

_____ Food concentrate _____

_____ 50 feet of nylon rope _____

_____ Parachute silk _____

_____ Portable heating unit _____

_____ Two .45 caliber pistols _____

_____ One case of dehydrated milk _____

_____ Two 100 lb. tanks of oxygen _____

_____ Stellar map _____

_____ Self-inflating life raft _____

_____ Magnetic compass _____

_____ 20 liters of water _____

_____ Signal flares _____

_____ First aid kit, including injection needle _____

_____ Solar-powered FM receiver-transmitter _____

How International and Intercultural Is YOUR Class?

Use the chart below to critique the atmosphere of your classroom. Keep in mind that the areas of emphasis may or may not be within your direct control as the classroom teacher.

EMPHASIS	SCORE: Superb, Good, Satisfactory or Needs Improvement	EXAMPLE
Culture		Is there a focus on discovering a cultural heritage increasingly influenced and transformed by a globalized world?
Climate		Do you encourage students to consider multiple perspectives in order to foster tolerance and respect, to develop empathy and understanding, and to promote acceptance of others' rights in being different?
Student Body		Are your classes heterogeneous, with students from many nationalities and with diverse cultural heritages?
Curriculum		Does your content area allow for connections to real-world issues and varied manifestations of cultures? How well do you promote these issues?
Resources		Do you and your students have access to resources in the school and community that allow further exploration of global issues, cultural development, tolerance etc?
Commitment to Reflection		Are your students given opportunities to consider the impact that multiculturalism has on their lives , their school, their community, their nation and the world?
Commitment to Extension		Are your students encouraged to look beyond the classroom as they develop an international and intercultural awareness? Do you promote involvement in activities and services that provide hands-on experience in these areas?

Example 2

Promoting Intercultural Awareness

Developing intercultural awareness is an ongoing process which concerns everyone within the school. Listed below are different ways in which many MYP schools reflect on and promote this fundamental principle of the MYP. This list can be used to promote reflection and discussion among school staff as the school implements and develops the programme.

Summary of ideas shared by some MYP schools

School Philosophy and Culture

MYP schools suggest a number of ways of making intercultural awareness part of the school culture and climate.

- Develop a school's mission statement which clearly communicates a philosophy of intercultural understanding.
- Look for international experience and multicultural diversity when recruiting staff.
- Include reflection on intercultural awareness when organizing staff meetings, professional development activities and teacher appraisal.
- Encourage teachers to become familiar with the cultures of the students in the school.
- Empower students through committees, student government, discussion of student rights and responsibilities, involvement in establishing codes of acceptable behaviour.
- Establish clear expectations and discipline procedures requiring individual responsibility based on respect for individuals and the community; encourage self-discipline and self-respect.
- Reflect on and communicate the values inherent in this philosophy; discuss situations and their consequences rather than preaching 'right and wrong'.

Curriculum

Intercultural awareness should also pervade the curriculum.

- Select syllabus content which illustrates multiple perspectives on events.
- Choose activities which require analysis of similarity and difference, in order to develop the understanding that different does not necessarily mean better or worse.
- Use homeroom and special classes to consider the notions of universal values and human rights; discuss radically different sets of values; discuss whether we should tolerate intolerance.
- Consider teachers as more than subject specialists: mentors, advisors, role models.
- Be concerned with developing emotional as well as academic intelligence.
- Use fundamental guiding questions for personal and group inquiry which involve reflection on cultural issues.

- Encourage or require national cliques to mix for class activities; discuss the impact of national groups in the school and encourage more mixing.

Languages

- Require or at least facilitate native language learning for all students.
- Encourage students to speak in different languages around the school.
- Make a number of learned language options available to students.
- Include cultural studies relating to the host country in the curriculum.
- Have students read and discuss world literature in translation.

Other Subjects

- In sciences, explore global and environmental issues where relevant, also considering the national and cultural contexts.
- Discuss different perspectives on historical events, develop empathy, learn to detect bias in historical commentary.
- Study comparative culture and religion; acknowledge and respect religious festivals
- In physical education, develop team skills, learn sports from different countries.
- In arts, investigate artistic traditions from other cultures.
- Produce types of music, art, theatre from different cultures.

Areas of Interaction

When planning the integration of the five areas of interaction, schools should consider their role in promoting intercultural awareness.

- Consider and discuss global issues concerned with health and social education, *homo faber*, environment and community service, through regular class teaching and special events and activities.
- In approaches to learning, consider similarities and differences in teaching and learning styles in different cultures.
- Use community service activities to pay special attention to other nationalities and cultures both inside and outside the school (for example, start a "buddy system" for new students and students who have difficulty with the language of instruction).
- Include discussion of intercultural awareness in areas of interaction leaders' meetings.
- Teach students mediation and conflict resolution skills.
- Favour activities which develop appropriate attitudes and skills, such as team building exercises, challenge projects.

Organize activities and projects which reflect global issues related to the areas of interaction, such as Model United Nations, Youth Parliament, activities linked to Amnesty International and/or the Peace Curriculum developed by the International Schools Association.

Promoting International Mindedness in Our Schools

The Dalai Lama said, that "more calm, more peace, more compassion, more international feeling is very good for our health." More peace, compassion and international feeling are also central to the IB mission. In this article I will explore the importance of international mindedness and some implications for teachers and school leaders. Although I am starting from a regional perspective, the very nature of international mindedness makes it imperative to view these ideas as pertinent to schools in the four regions of the IBO.

Most of the IB schools in the IBNA region are not "international" in the traditional sense of the word--they do not cater to an expatriate community with English as the language of instruction in a host country with another native tongue. In our region, most IB schools teach students from the local community. They often have classes with large numbers of immigrants, but are nevertheless local, neighborhood schools. We must derive our claim to being an "international school" from the curriculum itself.

What unites the IBO community of schools is our commitment to an integrated international curriculum. A recent study by Kenneth Tye concluded, "throughout the world, schooling is still seen as a major force in the building of national loyalties." [1] National, provincial and state curricula have always been designed to instill the values, history and perspectives of a particular society. The IBO offers local schools an international program for the entire school continuum, reaching beyond the local context.

"International mindedness" remains a challenging concept to define and bring alive in our schools. School leaders contribute to the development of the skills, knowledge and attitudes of the teachers in many ways. In IB schools, there is a clear obligation to explore the meaning of internationalism and to give our teachers and school communities powerful reasons to embrace it in their teaching and planning. In each of our schools, it will be important to explore the following questions with all stakeholders (community, parents, teachers, students).

1. Why is it important to foster internationalism in education?
2. What will international mindedness look like in my classroom and in my students?
3. How do we build curriculum around the principles of internationalism as expressed in the IBO mission statement?

1. *Why is it important to foster internationalism in education?*

As the recent tsunami in Asia demonstrated with a terrible clarity, the interdependence of peoples, communities and nations is becoming ever more palpable. Conflicts in far flung places impact people around the globe in complex and unexpected ways. The environment is struggling to absorb the impact of six billion people on the planet. Martin Gannon once said, "There are as many reasons, and perhaps more reasons, supporting the view that global disintegration may be our fate rather than global integration." [2]

To avoid this fate is one of the goals of international education. Children educated for tomorrow's world must be equipped with the habits of mind that will allow them to act in meaningful ways, whether locally or globally. It is as important to understand the "other's" point of view as it is to understand one's own. When we learn to view our world not as "us and them" but as "us and us" we will come closer to finding fair and just solutions to the issues facing humanity. An education that promotes international mindedness will provide young people with

the skills, knowledge and values to confront these challenges and make meaningful contributions to their solutions.

2. *What will international mindedness look like in my classroom and in my students?*

There are overt as well as subtle ways to promote international mindedness in our students. The foreign language requirement of the program promotes internationalism by valuing the language of another culture. While the flags, international days and trips abroad are a starting point, the goal is to develop a deeper understanding of another culture. What we are striving for is not flag recognition, but the development of intercultural awareness, which will foster a sense of cultural identity in our students. When we introduce our students to inquiries into the cultures, histories and beliefs of others on our planet and look for commonalities, we begin the development of international mindedness. Knell and Wartella observe that, "International education builds respect and ties between nations, advances learning and scholarship, and is a powerful force in replacing myths and misinformation with knowledge and understanding." [3]

An international curriculum guides our students in developing the knowledge, values and skills necessary to be citizens of the world. Developing interpersonal and communication skills as well as thinking and research skills allows our students to be open-minded and inquiring individuals. Our classrooms must offer rich and varied opportunities to develop these skills.

Young people may not be able to care about global issues without knowledge of the world beyond their local communities. Knowledge will lead to caring, and caring will lead to action. Through action, our students can contribute to the building of a better world, whether it be through a fund raising activity for distant tsunami victims or a clean up in our own backyard. Thoughtful curriculum design will help our students develop an international knowledge base so they can develop the capacity for the action that is integral to the three programs of the IBO.

3. *How do we build curriculum around the principles of internationalism as expressed in the IBO mission statement?*

Applying the concepts of internationalism to curriculum development can help teachers impart international knowledge and understandings in their classrooms. Whatever level of the IB programs a school offers, an examination of the central concepts of internationalism within the context of the school should become an integral part of curriculum planning. The design of curriculum will come to include the conceptual frames of:

- the role of culture in our lives and the lives of others
- the interdependence of natural and human systems on our planet
- the role of peace education and conflict resolution in our world
- environmental awareness and sustainability
- citizenship and service as an expression of individual responsibility.

As internationalism becomes more meaningful to teachers, they will begin to make important connections to their own disciplines and programs. Ongoing reflection from all participants--administrators, teachers and students--will enrich the internationalism in the curriculum.

For the Primary Years, Middle Years and Diploma Programmes, internationalism has different applications, but not different meanings. Our commitment to international mindedness is the central idea of our program. Internationalism must be integrated into all learning rather than viewed as an add-on subject. It is the task of both individual teachers and whole schools to

make it implicit at all levels of learning. The principles outlined in the *IBO mission statement* illuminate this goal:

> The International Baccalaureate Organization aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.[4]

H.G. Wells wrote, "Human history becomes more and more a race between education and catastrophe."[5] As we consider the ravages of the past century, resulting from both conflict and progress, this statement takes on a renewed urgency. A deep understanding of the interdependence of nations, cultures, peoples and our fragile planet will be a prerequisite for the healing of our natural and political environments. An international education will lead young people to acquire the tools needed for them to understand and create a more secure, sustainable existence on this planet. If we must leave them with a difficult legacy, then we owe it to the next generation to also provide them with the tools they will need to make the necessary changes. The international curriculum we promote through the IB will give them these tools. To paraphrase H.G. Wells, let the race begin!

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1 Tye, Kenneth A., "Global Education as a Worldwide Movement," *Phi Delta Kappan*, October 2003.
2 Gannon, Martin J. 2004. *Understanding Global Cultures, Metaphorical Journeys Through 28 Nations, Clusters of Nations, and Continents, 3rd Edition*. Thousand Oaks, CA. Sage.
3 Wartella, E., Knell, Gary E., "Raising a World-Wise Child and the Power of Media," *Phi Delta Kappan*, November 2004.
4 IBO Mission Statement, 2002.
5 Wells, H.G., 1920. *The Outline of History, Being a Plain History of Life and Mankind*

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Source: *Beyond Culture* (1976) by Edward T. Hall

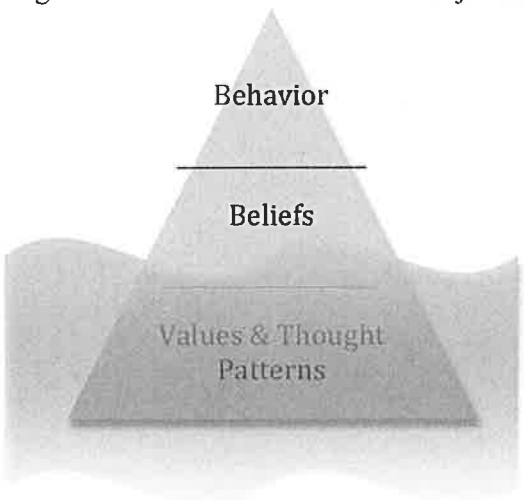
Edward T. Hall's Cultural Iceberg Model

In 1976, Hall developed the iceberg analogy of culture. If the culture of a society was the iceberg, Hall reasoned, than there are some aspects visible, above the water, but there is a larger portion hidden beneath the surface.

What does that mean?
The external, or conscious, part of culture is what we can see and is the tip of the iceberg and includes behaviors and some beliefs. The internal, or subconscious, part of culture is below the surface of a society and includes some beliefs and the values and thought patterns that underlie behavior.

There are major differences between the conscious and unconscious culture.

Internal	versus	External
Implicitly Learned		Explicitly Learned
Unconscious		Conscious
Difficult to Change		Easily Changed
Subjective Knowledge		Objective Knowledge



What can we do?
Hall suggests that the only way to learn the internal culture of others is to actively participate in their culture.

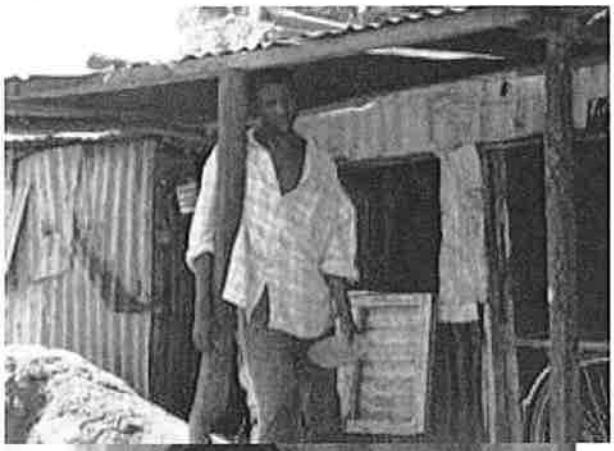
When one first enters a new culture, only the most overt behaviors are apparent. As one spends more time in that new culture, the underlying beliefs, values, and thought patterns that dictate that behavior will be uncovered.

What this model teaches us is that we cannot judge a new culture based only on what we see when we first enter it. We must take the time to get to know individuals from that culture and interact with them. Only by doing so can we uncover the values and beliefs that underlie the behavior of that society.

If the World Were a Village of 100 People

If we could reduce the world's population to a village of precisely 100 people, with all existing human ratios remaining the same, the demographics would look something like this:

The village would have 61 Asians, 13 Africans, 12 Europeans, 9 Latin Americans, and 5 from the USA and Canada



50 would be male, 50 would be female

75 would be non-white; 25 white

67 would be non-Christian; 33 would be Christian

80 would live in substandard housing

16 would be unable to read or write

50 would be malnourished and 1 dying of starvation

33 would be without access to a safe water supply

39 would lack access to improved sanitation

24 would not have any electricity (And of the 76 that do have electricity, most would only use it for light at night.)

8 people would have access to the Internet

1 would have a college education

1 would have HIV

2 would be near birth; 1 near death

5 would control 32% of the entire world's wealth; all 5 would be US citizens

48 would live on less than US$ 2 a day

20 would live on less than US$ 1 a day

Disclaimer: This presentation is for the purpose of fostering understanding of the different cultures of our world. When one considers our world from such a compressed perspective, the need for cooperation, tolerance and understanding becomes glaringly apparent.

As to the accuracy of all statistics: With so many newly published reports resulting in constantly-changing and sometimes conflicting statistics, please view the above presentation for the general content and not meant to be totally precise.

http://www.familycare.org/special-interest/if-the-world-were-a-village-of-100-people/

Learning is best supported when set in the context of the exploration of relevant content. MYP students should be invited to investigate significant issues by formulating their own questions, designing their own inquiries, assessing the various means available to support their inquiries and proceeding with research, experimentation, observation and analysis that will help them find their own responses to the issues.

An MYP classroom is a lively and balanced classroom, in the sense that teachers will balance the pursuit of understanding and the construction of meaning with the acquisition of knowledge, skills and attitudes.

To create productive and effective learning environments, teachers need to ask carefully thought-out, open-ended questions and encourage students to ask their own questions. This will require teachers to provide resources and support for each student to become involved in inquiry, using the tools and strategies that best fit the student's development and ways of learning. By striving to provide secure learning environments in which the individual student is valued and respected, teachers can provide students with varied cultural and other perspectives on a range of contemporary and historical issues. An explicit expectation of the MYP is that successful inquiry will lead to meaningful reflection and to responsible action initiated by the students as a result of the learning process.

Teaching in the MYP has	
increased emphasis on:	**decreased emphasis on:**
using a range and balance of teaching strategies	over-reliance on a limited set of teaching strategies
working collaboratively, grouping and regrouping students for a variety of learning situations	over-reliance on one grouping strategy
viewing students as thinkers with their developing ideas of the world	viewing the teacher as the sole authority
building on what students know (constructivism)	focusing on what students do not know
using multiple resources representing multiple perspectives	over-reliance on one teaching resource from one culture
empowering students to feel responsible and to take action	teaching about responsibility and the need for action by others
involving students actively in their own learning	viewing students as passive recipients
pursuing open-ended inquiry and real-life investigations	a teacher-directed focus on rigid objectives
awareness of the language needs of those learning in a language other than a mother tongue	teaching strategies suitable only for those learning in their mother tongue
addressing the needs of students with different levels and types of ability.	employing teaching strategies suitable for one level and type of ability.

Learner-Centered Instruction
By: Paul Kim

Model	Attributes
Inquiry	• A learner-centered, active learning approach focusing on questioning, critical thinking, and problem solving • Follows the principle that involving learners will help them better understand the lessons
Resource-based learning	• Learners actively engage in multiple resources (print and non-print) • Learners responsible for selecting resources (e.g. Internet, books, human) that appeal to their personal learning preferences, interests and abilities • Learners become active learners as they use a wide range of materials to investigate subject material prescribed within their classroom curriculum
Cognitive Apprenticeship	• Learners work in teams on projects or problems with close scaffolding of the teacher • Guided participation helps the learner achieve tasks that independently would be too hard or complicated. • The task or goal is to form a process of thinking—or something that is intangible into something tangible • Teachers usually model or scaffold the skills or tasks in the beginning. Once learners begin to understand, the modeling and scaffolding is reduced. This allows learners to accomplish the task on their own and only ask for help when needed
Problem-based learning	• Focuses on the process of problem solving, critical thinking in situated contexts, and acquiring knowledge. It is inquiry-based when learners are active in creating the problem • Emphasis is placed on using communication, cooperation, and resources to formulate ideas and develop reasoning skills • Knowledge is constructed within each individual or community based on the learner's or community's prior knowledge, values, beliefs, and perspectives. • Learning occurs through social interactions whereby an outside source can help individuals extend their learning • Activities are organized around achieving a shared goal (project)
Project-Based Learning	• Focuses on developing a product or creation • Engages learners by starting with concrete and solving hands-on, real-world problems • Learners are usually provided with specifications for a desired end product (e.g a specific project, such as building a rocket or designing a web site) • The learning process is more oriented to following correct procedures. • Teachers are more likely provide expert guidance, feedback and suggestions (e.g. modeling, scaffolding) to help learners achieve the final product. This is provided according to learner needs and within the context of the project • Activities are organized around achieving a shared goal (project)
Collaborative Learning	• Learners placed in groups or pairs for the purpose of achieving a common academic goal • Learners are responsible for one another's learning as well as their own. Thus, the success of one learner helps other learners to be successful • Does not require face-to-face interaction as collaborative learning can take place across the Internet
Cooperative Learning	• It is a specific kind of collaborative learning, where learners work together in *small* groups on a structured activity. They are individually accountable for their work and are responsible for helping teammates learn • Cooperative groups work face-to-face and learn to work as a team

Constructivism	• Founded on the premise that reflecting on personal experiences allows learners to construct their own understanding of the world • Teachers focus on making connections between facts and fostering new understanding in learners • Teachers rely heavily on open-ended questions and promoting extensive dialogue among learners • Learners encouraged to analyze, interpret, and predict information

Supporting student inquiry (section 7 page 52 P2P)

As outlined in the programme model, the curriculum framework recognizes and values students' efforts to construct meaning when exploring the world around them. To support this, the MYP requires teachers to provide learning experiences that draw on students' prior knowledge and provide the time and opportunity for reflection and consolidation. This **constructivist** approach respects students' ongoing development of ideas and their understanding of the wider world. It implies a pedagogy that includes student inquiry into significant content in real-world contexts. This pedagogy leads to the most substantial and enduring learning.

The construction of meaning and the development of conceptual understanding are supported in the MYP by the acquisition of knowledge and the development of skills and attitudes that have a context. This is the way in which students learn best—they should be invited to investigate significant issues by formulating their own questions, designing their own inquiries, assessing the various means available to support their inquiries, and proceeding with research, experimentation, observation and analysis that will help them find their own responses to the issues. The starting point is students' current understanding, and the goal is the active construction of meaning by building connections between that understanding and new information and experience, derived from the inquiry into new content. It is further recognized that not all learning in the MYP will take place in an inquiry setting.

Forms of inquiry

Inquiry can take many forms, yet the most successful form is when students' questions and inquiries are genuine and take them from existing knowledge to new levels of understanding. An explicit expectation of the MYP is that successful inquiry will lead to meaningful reflection and to responsible action initiated by the students as a result of the learning process. This action may extend the students' learning, or it may have a wider social impact. Both inquiry and action can look very different from age 11 to 16.

When engaging with an MYP unit of work students can use the inquiry cycle (see figure 4 in the section on "The areas of interaction") to:

- make connections between previous learning and current learning
- experiment and play with various possibilities
- make predictions and take action to see what happens
- collect data and report findings
- clarify existing ideas and reappraise perceptions of events
- deepen their understanding through the application of a concept
- make and test theories
- research and seek information
- take and defend a position
- solve problems in a variety of ways.

LINEAR OR NOT?

In this activity, you will learn how to tell if an equation represents a line by simply looking at it. You will need a graphing calculator and will work with one other person.

I. To begin, in your notebook make a table with two columns, one labeled "LINEAR" and the other "NON-LINEAR". You will need about 15 rows.

LINEAR	NON-LINEAR

On your graphing calculator, draw the following graphs one at a time. Every time you find one that is a line, write its equation in the "Linear" column. Equations of non-linear graphs go in the other column. After the first ten, try to guess if the equation will produce a linear graph before graphing it. (HINT: You may need to play with the WINDOW in order to better see the graph. Some graphs appear linear when zoomed out but are actually non-linear when you see them with a more appropriate scale.)

EQUATIONS:

$y = x^2 - 5$	$y = 3x + 9$	$y = \sqrt{2x - 8}$	$y = \frac{4}{x}$
$y = \frac{1}{2}x - 3$	$y = 9 - x$	$y = 2x^3 - x + 4$	$y = (x + 2)(x - 4)$
$y = -6x$	$y = 2^x + 5$	$y = \sin x$	$y = 1.2x + 24$
$y = \frac{x + 3}{x - 5}$	$y = \frac{2x - 6}{3}$	$y = \lvert x - 4 \rvert + 3$	$y = \frac{x}{4} - 2$
$y = \frac{-2}{x^2}$	$y = x$	$y = 3(2x - 12)$	$y = \frac{1}{\sqrt{x + 2}}$

Looking at your results, how can you tell if an equation represents a line or not? Write your rule in your notebook and show some examples of what you mean.

II. Not all equations are given in the form "y = …" and, therefore, using a graphing calculator might not be appropriate. For each of the following equations, fill in the table and then sketch a graph based on the points. The goal is to figure out which equations represent lines. Again, write the equations in the remaining space in the table you've been using.

$x^2 + y^2 = 100$ Sketch

x	y
0	
0	
	0
	0
6	
-6	
8	
-8	

$2x + 3y = 12$

x	y
0	
	0
3	
-3	
-6	

$x - 4y + 8 + 0$

x	y
0	
	0
4	
-4	
8	

In the space between the given equation and your graph, rewrite the equation so that the "y" is isolated (by itself on one side).

Based on your graph and the rewritten equations, do these equations follow the rule you established previously? If not, how should you change your rule to fit this new information?

III. Using the graphing calculator, graph the equations of the linear relationships from the original table one at a time and fill in the following. (HINT: Use the version where "y" is isolated.)

LINEAR RELATIONSHIP	SLOPE (m)	Y-INTERCEPT (b)

What do you notice about the numbers in the equation? How is this information helpful? Summarize what you found using mathematical symbols.

IV. Pick any three of the equations from the last table and write them in the first column in the table below:

EQUATION	Point A	Point B	Slope	y-intercept

For each equation, find one point on the line. Write it in the second column.
(HINT: Choose a value for "x" and find the corresponding "y" value.)

Find a second point in the same way and write it in the column marked "Point B".

Using the two points and the formula for slope from last class, find the slope of each line. How do they compare to what you wrote in the last table?

Find the y-intercept of each line (if you haven't already) by plugging in the appropriate value for "x". How do these values compare to what you wrote previously?

You have just figured out that, once you know that an equation represents a line, there are TWO ways of finding the line's slope and its y-intercept. What are they?

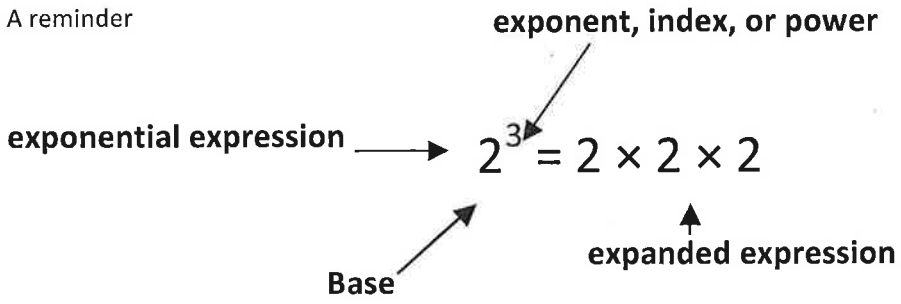
METHOD 1:

METHOD 2:

QUESTION: What does it mean when we say that there is a "linear relationship" between variables? How is that different than one that is "nonlinear"? What do the slope and y-intercept represent in linear relationships?

Exponential evidence

A reminder



A: Multiplying exponential expressions with the same base

Directions: In this first activity, you are going to predict what happens when you multiply **exponential expressions** together which have the same base. Then, you are going to look over some ***exponential evidence*** that will help you determine whether or not your prediction was accurate.

1. Making a Prediction

Each of the answers to the problems below can be written as **exponential expressions**. Predict each answer then explain, in words, why you made that prediction.

$5^3 \times 5^4 =$ $3^5 \times 3^2 =$ $a^m \times a^n =$

2. Examining the evidence

Examine each of the following pieces of evidence to help you decide whether the predictions you made above were correct.

Evidence Sample #1: To simplify the following problem,

- write each exponential expression as an ordinary number,
- multiplying the numbers together and then,
- re-write the answer as an exponential expression

$$2^4 \times 2^2 =$$

Does the evidence from this problem support the predictions you made?

_____

_____

_____

Evidence Sample #2: To simplify the following problem,

- write each of the exponential expressions in expanded form,
- write the answer to the problem in expanded form and then,
- simplify your answer by re-writing the expanded form as a single exponential expression

$$4^3 \times 4^5 =$$

Does the evidence from this problem support the predictions you made?

_____

_____

Evidence Sample #3: To simplify the following problem,

- use a scientific calculator, or GDC, to calculate the answer and then,
- re-write the answer as an exponential expression

$$5^2 \times 5^4 =$$

Does the evidence from this third problem support the predictions you made?

3. Drawing conclusions

Based on the evidence you have collected from the three samples above, what conclusion can you come to about what happens when exponential expressions with the same base are multiplied together?

Holistic education has become a familiar topic within the current education literature but there are conflicting opinions about what holistic education represents and a single definition remains elusive. There have been claims that holistic education reflects the education of the whole child but little clarity is offered to explain what this means, and in a field of education that is somewhat diverse, it is not surprising that there is confusion over what holistic education represents.

The purpose of this paper is to bring some clarity to what is meant by holistic education and outline the characteristics and outputs associated with it. This lack of clarity is an obstacle for teachers, parents and students alike and has the potential to obscure the advantages that this educational approach offers. Furthermore, such clarity would facilitate a comparison with other educational initiatives and allow curriculum designers to test their claims about whether they are delivering a programme of holistic education.

What is holistic education?

Holistic education does not exist in a single, consistent form. It is best described as a group of beliefs, feelings, principles and general ideas that share a family resemblance (Forbes, 2003: 2). It is more than the education of the whole student and addresses the very broadest development of the whole person at the cognitive and affective levels. It emphasizes the education of the student beyond the confines of the classroom and moves the concept of a child-centred educational approach to a much more radical programme of education.

Holistic education focuses on the fullest possible development of the person encouraging them to become the very best or finest that they can be and enabling them to achieve their ultimate life experiences or achievements (Forbes. 2003: 17). These experiences or achievements can be rare, special and deeply meaningful experiences for the individual or could represent a position, role or vocation that they perceive as unique or special and is an important goal in their life.

This could be described as the "vision" of holistic education. The aim of holistic education must be to prepare the student for a fulfilling and productive life in which their skills and attributes are constantly challenged, developed and applied as part of their life-long learning. It is an educational journey of personal discovery starting within formal education and then continuing throughout life. The learning and life experiences are continuous with individuals gaining in different ways from the various situations and demands that they are presented with. It could be argued that this is the aim of any good educational system. This is not disputed but whilst there remains a predominant focus on the value of a knowledge-based educational system then the advantages of holistic education will not be realised.

What are the features of holistic education?

A programme of holistic education aims to encompass all aspects of personal learning and growth and emphasizes the development of active relationships at all levels whether these are between the subject domains, between individuals and their peer groups and communities or between the individual and the world around them. Miller (1991: 3) has proposed that education may be described as holistic when it exemplifies the following characteristics:

- Holistic education nurtures the broad development of the student and focuses on their intellectual, emotional, social, physical, creative/intuitive, aesthetic, and spiritual potentials.
- It promotes the importance of relationships at all levels within a learning community in which the educator and student work together in an open and collaborative relationship.
- There is an emphasis on life experience and learning beyond the confines of the classroom and the formal educational environment towards education as growth, discovery and a broadening of horizons. It encourages a desire to elicit meaning and understanding and to engage with the world.
- The approach empowers learners to examine critically the cultural, moral and political contexts of their lives. It leads learners towards actively challenging and changing cultural values to meet human needs.

Even a brief comparison of these characteristics with the aims and objectives of the IB programmes will reveal common features. These characteristics can be applied within any of the IB programmes and furthermore complement the continuum of IB programmes.

Holistic education has the capacity to lead the student into new areas of thinking, to broaden their personal and critical thinking and develop an appreciation of the world around them and realise the importance that relationships have within all these considerations. Importantly, holistic education has the capacity to empower students to think differently, to think creatively and reflect on their own values.

Undoubtedly, teachers would encourage their students to develop into well-educated, informed and participating members of society. This aim is accommodated within holistic education and offers teachers a framework within which to work as it seeks to develop students actively beyond academic excellence alone.

Towards a profile of a holistically educated student – the Student profile

Since a single definition of holistic education is elusive, the challenge is to identify what the outputs of a holistic approach to education represent. In this way, teachers, parents and students can identify what is being aimed for and recognise the benefits that this approach can bring.

Holistic education can be associated with a number of recurring themes and values; the family resemblances that were referred to earlier (Forbes 2003: 2). These values are "guidelines for personal behaviour" (Thompson, 1993) and it is these personal behaviours that characterise the outputs of the holistic approach. The behaviours reflect a range of capabilities, skills and competencies that the student will begin to develop as they emerge from a formal programme of holistic education (Hare, 2006). The behaviours and attributes associated with holistic education have been drawn together as outputs within a ***student profile***, the significant features of which are shown below.

- **Acts with social and academic maturity and integrity.**

They are confident and at ease with individuals and groups with which they may be unfamiliar and show respect for the culture, opinions and values of others. They challenge accepted wisdom maturely and develop their own understanding from this experience. They learn from their errors, take responsibility for their actions, and acknowledge the input and contributions of others.

- **Takes ownership of their own development and learning through planning and prioritization. They independently ensure that tasks are completed on time.**

They take responsibility for their own personal and academic growth and the outcomes. They can set clear and realistic targets, prioritize conflicting demands and plan for success. They persist in their tasks and maintain high standards in their outcomes.

- **Demonstrates flexibility and a creative approach to problem solving.**

Consistently, they can think creatively and laterally using approaches from a number of disciplines and experiences. They feel empowered and confident to find solutions and will take risks in new and unfamiliar areas of thinking and action.

- **Through their interpersonal skills, develops and maintains relationships.**

They act with care, consideration, compassion and empathy in their interactions with others from a variety of backgrounds. They learn from their interactions with others. Through active listening and open-mindedness they are ready to consider and accommodate views and opinions which challenge their own thinking.

- **Demonstrates a reflective approach and an attitude of continuous improvement.**

They consider and review their work objectively and reflect on better ways of performing the task and raising standards when the task is repeated so that improvements are made in the future.

- **Demonstrates effective written and oral communication skills**

They use the most appropriate way of delivering information in a variety of contexts and situations and appreciate the expectations and needs of the audience. They have sufficient confidence to change and adapt their style of communications should the situation and circumstances change.

- **Demonstrates good meeting management and involvement behaviours**

They contribute actively and collaboratively to support group discussions and meetings. They challenge others with respect and support and develop the ideas of others to encourage the decision making process.

- **Seeks to bring clarity to decision making**

They bring clarity to the plans and activities that are needed to complete any tasks. They consistently look for ways to exceed standards and expectations and learn from their actions for the future.

- **Through an understanding of their subject areas, their interdependencies and interrelationships, they can appreciate the interconnections in human knowledge; they can appreciate and debate global issues and the impact of human activity on the environment.**

They develop a sound knowledge and understanding of the subjects that they study and can identify the features that draw the subjects and information together as a coherent whole. They are able to transfer skills between disciplines.

From their interaction with others, their experiences and learning, they take a considered global perspective on international concerns and bring an informed appreciation of the issues relevant to these concerns.

- **Uses effectively the information resources that are made available to them to assist in the acquisition of further knowledge and its relevant application.**

They can use data and information management methods effectively, including electronic data and library resources. They can evaluate effectively the value and content of data that they collect and use it appropriately.

None of the skills and attributes that are associated with any one output exists in isolation. A brief inspection of the outputs indicates that there are skills and competencies that are common within several of the outputs. Furthermore, all of these outputs can be regarded as interdependent and consequently, a focus on any single output will similarly address the development of others.

These outputs should not be interpreted as representing definitive end points that must be achieved within the years of formal education. The skills and attributes supporting a holistic

approach to education will develop at different rates and reflect the maturity of the individual, their personal experiences and the relationships that they develop and benefit from. As the student matures, these skills and abilities will serve them well in understanding their role in society, the contribution that they can make and lead them to appreciate the potential that they have to offer.

Learning is envisaged as a life-long experience. A major difference between the holistic approach and the familiar knowledge-based approach is that the former adopts a planned and considered approach to students' development beyond academic considerations, and at the very broadest level. An emphasis is placed on relationships and the learning emerging from these and takes the student beyond the confines of a knowledge-based education. This delivers personal and interpersonal skills that will bring considerable advantages to their progress beyond the years of their formal education.

The IB learner profile and the Student profile

The IB learner profile outlines the attributes and aspirations of internationally-minded students engaged in the IB programmes. In common with the student profile, the learner profile identifies educational outcomes at the academic, personal and interpersonal levels. A comparison of both profiles reveals striking similarities, for example, "communicators" within the learner profile has features in common with,

- Acts with social and academic maturity and integrity
- Demonstrates good meeting management and involvement behaviours

within the student profile.

The comparison offers evidence that the outputs of holistic education complement the educational aims within the continuum of the IB programmes and consequently all the IB programmes. Furthermore, since the student profile reflects the outputs of a holistic approach to education, this comparison suggests that the IB programmes also support that holistic approach.

The implications of holistic education.

Holistic education is a clear departure from the knowledge transmission approach to education that has been familiar in the past. Holistic education prepares a student for life-long learning in which the educational focus moves towards the life-skills, attitudes and personal awareness that the student will need in an increasingly complex world. The commitment to the subject knowledge of the student is maintained but is complemented by learning how to learn,

the critical evaluation of knowledge gained and the use of this knowledge in a broad range of contexts; it is these that represent the education currency of the future.

Consequently there is an emphasis on a broad educational approach that addresses the intellectual, personal and interpersonal development of the student and puts in place many of the values, attitudes and skills that will serve the student well in their later years. Such a broad development cannot be claimed by the knowledge-laden education systems that have predominated for so many years and brings closer the realization of "learning to be" and "learning to live together" that have been identified in the Delors report (UNESCO 1996: 14).

This broad development of the student must be carefully planned at the individual level and has obvious repercussions on teaching strategy, curriculum design and the assessment of progress. The evaluation of the "soft" personal skills such as integrity, care, consideration, negotiation, and active listening has never been easy, but these are the new challenges in educational assessment. The skills and attributes will constantly be in dynamic development as various situations and scenarios present themselves in which these skills are necessary and appropriate. Evaluative information must be sought on behaviours and actions from a number of sources and in a range of situations and these fed back to the student in a constructive and supportive manner. These behaviours lend themselves to peer review and informal assessment. This could be problematical and brings into focus the importance of the relationship of the teacher and student and between groups of students. Simply offering an assessment in terms of effort and a grade will no longer suffice, such "soft" skills cannot be graded on any scale.

Holistic education calls for the student to take ownership of their own development. This ownership will take different forms at different ages and levels of student maturity. Nevertheless, it is a key element within holistic education and teachers will need to be at the forefront of driving this issue and encouraging this ownership.

The supportive role of the parent within holistic education is essential. The behaviours identified in the student profile will also manifest themselves outside the classroom and parents should recognize, encourage, and praise such positive behavioural changes.

Holistic education is a radical endeavor. Formal education is merely the starting point on this life-long learning process.

Holistic education: implications for the teacher.

Holistic education represents a new journey for both student and teacher and one in which both parties will grow and critically examine perhaps strongly held values and beliefs. For the educator this could be an unsettling experience; the teacher is moving out of the comfort zone of their subject specialisation into areas of personal uncertainty. No longer is the teacher depending on their subject expertise but they are guiding students in developing and examining

their own values and prejudices, their critical thinking and behaviours and confronting opinions that are new to them without clear demarcation of rights or wrongs. This is uncertain territory. Frequently this may be a joint journey of discovery for both student and teacher with the teacher bringing their greater life-experience to the learning process.

Holistic education challenges the teacher to think differently about student cognitive and affective development and to examine critically how they practice their craft. The working relationship between the student and the teacher changes; it becomes more inclusive, dynamic and egalitarian. The appropriate pedagogical approach will become one of active, planned interventions that are developed for a student to meet their development needs. The teacher's skills of facilitation, guidance and mentoring will feature strongly to promote learning and understandings at both the academic and social levels. The aim is for the student for example, to understand the importance of relationships, the different ways of regarding knowledge and its evaluation, the importance of life skills and the impact that the student has on others around them.

Teachers must also examine the learning culture within their school so that it is conducive to creating an inclusive learning community that stimulates the growth of a person's creative and inquisitive engagement with the world. The aim becomes the development of healthy curious individuals who can learn what they need to know and apply it in any new context in which they find themselves and who are self-motivated and confident learners.

Why is holistic education important and what advantages are there in understanding what it represents?

Holistic education brings breadth to the educational process. It represents a planned approach that encourages personal responsibility, promotes a positive attitude to learning and develops social skills. These are essentials in the modern world in which we live.

The identification of the outputs of holistic education has advantages. These outputs give students, teachers and parents clarity about the purpose of this educational approach. Furthermore, it allows parents and students to make an informed choice when they are confronted with different educational systems. The educational characteristics of the IB programmes have much in common with the outputs associated with a holistic approach to education. If parents favour a holistic approach to the education of their children then the IB programmes offer such an approach.

References

Forbes, S.H. (2003) *Holistic education: An Analysis of its Ideas and Nature*. Brandon, VT: Foundation for Educational Renewal.

Hare, J.R. (2006). Towards an Understanding of Holistic Education in the Middle Years of Education. JRIE, 5: 301-22.

Miller, R. (1991). "Introduction" in Miller, R. (Ed), *New Directions in Education*, pp1-3, Brandon, VT: Holistic Education Press.

Thompson, J.J. (1993) Education in an International Context module. University of Bath Summer School, July.

UNESCO (1996). *Learning: The Treasure Within*. The Report to UNESCO of the International Commission on Education for the Twenty First Century chaired by Jacques Delors. Paris: UNESCO

Design an MYP Classroom:

What inspires learning? With people at your table group, your focus is on how to design a classroom environment that best inspires learning. Consider the following categories to represent in the classroom:

MYP Principles	***Physical Arrangement***	***Content***
Consider these elements: • The learner profile • The IB mission statement • Intercultural Awareness	Consider these elements: • A room that fosters inquiry • A room that appeals to a variety of learning styles	Consider these elements: • All teachers are language teachers • Supports holistic learning • Taxonomy of thinking • Building life-long learners

International Baccalaureate

How does my classroom deliver the MYP?

Topic 5

International Baccalaureate

MYP unit planner

Unit title	
Teacher(s)	
Subject and grade level	
Time frame and duration	

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus		Significant concept(s)
Which area of interaction will be our focus? Why have we chosen this?	⇔	What are the big ideas? What do we want our students to retain for years into the future?

MYP unit question

International Baccalaureate

How do I plan a unit?

- Two approaches:
- Backward design (start with summative assessment to derive the stage 1 components)
- Content to concept (sometimes easier with math teachers to chunk the content of a unit and then look for the significant concept)

HOW DO WE GO FROM CONTENT TO CONCEPT?

Group Brainstorm

- Brainstorm as many content topics that come from school-based requirements or state/provincial standards in a year
- Choose **one** that would comprise a unit of work that would last somewhere between 4 – 6 weeks

The 3 C's

- CONTENT
- CONCEPT
- CONTEXT

CONTENT

- Brainstorm all of the "stuff" and skills learners need to know and do by the end of the unit

CONCEPT

- What is the big idea? Find the over-arching, significant concept in your content

Significant Concept?

- Real-life concept bigger and broader than the content (overarching, non-content specific statement)
- Could apply to more than one subject
- **ONE** broad idea written as a concise statement

(refer to "Evaluating unit planners")

Significant concept examples

"There may be a difference between theory and reality"

"There are myriad ways to express the same idea"

"The solution to a problem can be as important as the solution itself"

"The choices of one can affect all"

"Symbols are created to communicate meaning"

"There is a way to determine the truth of a situation"

Significant concept(s)

What are the big ideas? What do we want our students to retain for years into the future?

Everything has value.

CONTEXT

Areas of Interaction (why not ATL?)

- Environments
- Community and Service
- Human Ingenuity
- Health and Social Education

Areas of Interaction (AoI)

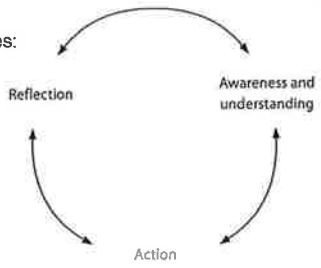
- Create content relevancy
- Can be content-specific (Significant concept cannot)
- Promote student inquiry

When planning a unit, you will want to consider this as a Student Learning Expectation for the unit in terms of that AoI

The Inquiry Cycle

Student Learning Experiences:

- Awareness of...
- Reflection upon...
- Action on...



Choosing an AoI

- Which ONE would be a BEST match with the significant concept? Why?
- The AoI can be more content-specific. Consider what aspect of the AoI you want kids to become "aware of" or "reflect on" or "act on" in that unit.
- Refer to: Subject guide, p.14 – 21. Principles into practice, p.20 – 27.

Area of interaction focus

Which area of interaction will be our focus?
Why have we chosen this?

Community and Service: Individuals, communities and governments have to budget to meet a variety of needs

Note: STUDENT LEARNING EXPECTATIONS (SLEs) will be mapped vertically to show a progression of learning but are not assessed

Writing a Unit Question – One Possible Method

Take your significant concept statement as it is and:

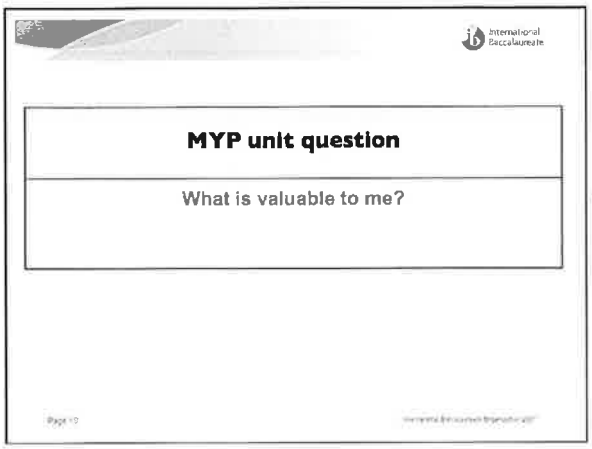
- **Invert it** into a question form – "How, why, etc."
- **Turn it** into a **student-friendly** question – Use me, my, our, I, to make it more from their point of view

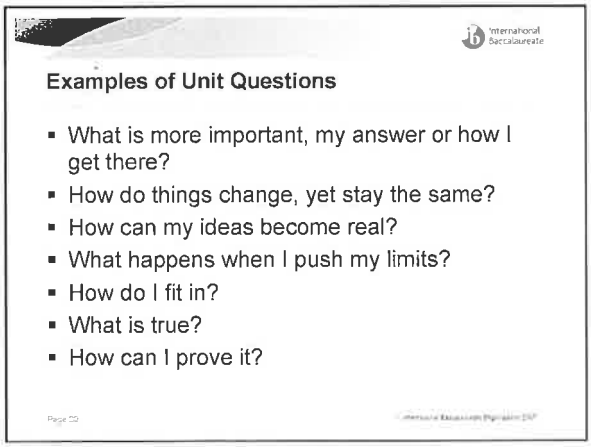
How do I know if I have a good Unit Question?

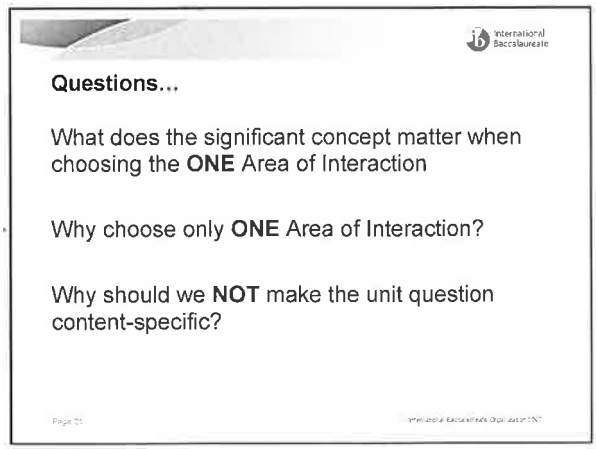
Ask if it is:

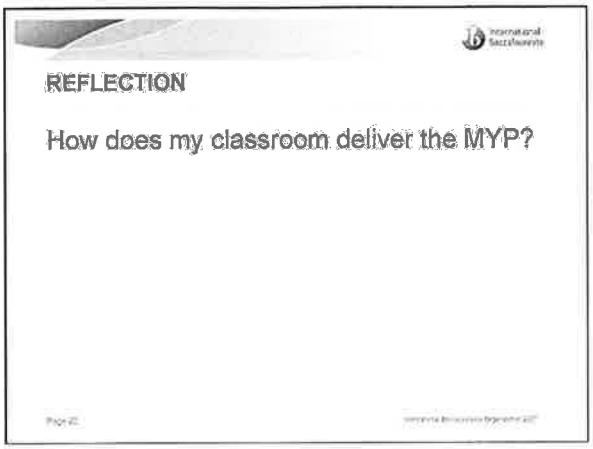
- Open-ended
- Relevant and engaging
- Challenging and provocative
- Significant (connected to something in a teenager's world)

Refer to: "Evaluating Unit Planners"


MYP unit question
What is valuable to me?


Examples of Unit Questions
What is more important, my answer or how I get there?
How do things change, yet stay the same?
How can my ideas become real?
What happens when I push my limits?
How do I fit in?
What is true?
How can I prove it?


Questions...
What does the significant concept matter when choosing the ONE Area of Interaction
Why choose only ONE Area of Interaction?
Why should we NOT make the unit question content-specific?


REFLECTION
How does my classroom deliver the MYP?

MYP Unit Planner - **POINTERS**

Unit Title	
Teacher(s)	
Subject/grade level	
Time frame/duration	

Stage 1: Integrate significant concept, area of interaction and unit question.

Begin by brainstorming all of the underlying concepts topics or skills, not concepts to be taught in the unit.

Area of interaction focus

Which area of interaction will be our focus? Why have we chosen this?

Health and Social Education

Human Ingenuity

Environments

Community and Service

*note: Every MYP unit of work will have an Approaches to Learning (ATL) component and will be addressed elsewhere in the planner.

Please choose only one AOI

Significant concept(s)

try to focus on just one

What are the big ideas? What do we want our students to retain for years into the future?

- Anchors learning in real life
- Perhaps it can become an interdisciplinary link if the teacher chooses to do so
- Try to make it broad – not just focussing on specific individual math skills

MYP Unit Question*

WORM ON A HOOK!

- Open-ended (no one right answer)
- Relevant and engaging
- Global (if you can...)
- Not value laden (does not use words like best, worst)
- Not a straight yes/no question
- Significant and engaging (*"grabs the attention of the students)*
- Kid friendly – can start with an adult version that links to your significant concept then modify it to work with your audience...

International Baccalaureate
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Middle Years Programme

Evaluating MYP unit planners

Middle Years Programme
Evaluating MYP unit planners

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Introduction

These rubrics have been developed as guidance for teachers who are developing MYP units of work. *MYP: From principles into practice* (August 2008) states that schools that do not choose to the use the MYP unit planner must use the processes of planning inherent in it.

Therefore, these rubrics will apply to **all** unit planners in MYP schools.

The planning stages

The MYP unit planner is made up of three parts.

- Stage 1 which is derived from the content
- Stage 2 which is content-specific
- Reflective stage which encompasses stage 1 and stage 2 and applies for the duration of teaching the planner and extends beyond

The following rubrics apply to stage 1 of the planner.

Rubrics for stage 1

This stage can be summed up as the integration of the specific key elements of creating MYP units of work, which always includes the following four steps:

- choosing a significant concept for the unit
- determining an area of interaction focus
- developing an MYP unit question that is specifically appropriate to the developmental age of the students
- determining a level of achievement using the process of summative assessment, addressing the MYP objectives listed in stage 2 of the planner.

Stage 1 ensures that units are in line with MYP philosophy and requirements; the stage is derived from subject-specific content.

Significant concept

The significant concept can also be considered the big idea of the unit. Upon consideration of the subject-specific content and concepts to be taught in an MYP unit, it is very likely that one big idea or concept will emerge.

The significant concept is usually a "real-life concept" and will be written as a statement. Examples are:

- "Communication is at the heart of relationships." (Language A)
- "Signs tell us where to go." (Mathematics)

Indeed, since the significant concept is a "real-life concept", teachers will more readily be able to determine the **one** area of interaction for the unit that could be considered the "best fit".

In both these examples, each significant concept stems from the subject-specific concepts to be taught. When developing a unit, a teacher will start by considering all the concepts that will be taught. By listing these concepts, teachers will be able to identify one that is the most significant. This will then become the significant concept or big idea for the unit and will be written as a statement, as demonstrated by the examples above.

Significant concepts transcend the subject and could possibly be used in other subjects, making this the authentic "interdisciplinary connection" of an MYP unit of study. This process provides opportunity for another subject area teacher to collaborate more easily in the creation of an interdisciplinary unit.

Descriptor	Level
The significant concept statement **fails to identify** a big idea, rather it identifies other aspects of learning such as **knowledge, skills or attitudes**.	0
The significant concept of the unit is apparent **only on close analysis** of the concept statement, although other **aspects of learning such as skills or knowledge** are included. It is **subject-specific**.	1
The significant concept of the unit is **included within** a concept statement, although it could **not be considered a real-life concept**. It could only apply to a **single subject** and its use in other subjects would not be appropriate.	2
The significant concept of the unit is clearly identified as a **real-life concept** and is written as a **concise statement**. The concept could apply to **more than one subject**.	3

The areas of interaction

The areas of interaction provide the contexts for learning; they are the ways in which the unit's content will interact with the "real world". *MYP: From principles into practice* (August 2008) states that teachers should choose one area of interaction for each unit. Approaches to learning skills are present in all units, therefore, the area of interaction focus should be drawn from one of the other four.

From experience of working with the planner, MYP practitioners have found that the clearer the unit's significant concept is, in terms of transcending specific content, the more easily connections can be made between the significant concept and the chosen area of interaction (the context for learning).

Once the area of interaction has been determined, its focus must be stated. This is an explicit indication of how the area of interaction will guide both teacher and student inquiry using the significant concept to make the actual subject content of the unit relevant to students.

Descriptor	Level
There is **little or no attempt** to show how student learning can be enhanced by the integration of any area of interaction.	0
More than one area of interaction is identified. These provide **little more than "links"** to the unit's concept that is **content-laden**. Multiple directions are implied—or some ideas are provided—for student inquiry, although these may have **little relevance** to the significant concept.	1
One area of interaction is stated and it may be approaches to learning. There is a **weak connection** that can be made with the identified concept. There is **an attempt** to show how teachers and students might use the area for inquiry, although the connections **might not be clear**.	2
One area of interaction (not approaches to learning) is **explicitly** stated and forms the context of the **entire unit**. It has **clear and close connections** with the identified significant concept/big idea. The area of interaction focus **guides** both teacher and student inquiry into the significant concept/big idea in a real-world context.	3

MYP unit question

The MYP unit question is the significant concept statement reworked in the form of a student-centred question; it specifically engages students, bringing a real-world context to their learning.

The question will need to be developed so that it satisfies the criteria proposed in the guide *MYP: From principles into practice* (August 2008) in the section "Planning for teaching and learning".

Use a best-fit approach to the rubric below in determining a level.

Open-ended	Relevant and engaging	Challenging and provocative	Significant	Level
The question:	The question:	The question:	The question:	
• is "closed", requiring a yes/no response (typical questions start with "can", "does", "should", "do", "will").	• does not provide for student involvement • fails to interest students.	• does not seek to extend students' capacities for new understandings.	• is irrelevant to students' lives.	0
• is content-specific • presumes that the answer could be known in advance, looked up or easily derived without serious thinking.	• is isolated from students' prior knowledge and experience • is phrased in adult language and adult thinking • provides for little student interest.	• provides few opportunities for students to develop their understandings or skills.	• requires a response based on factual recall or the simple stating of an opinion that has little depth • is teacher-centred or text-centred • has little relevance to students' lives.	1
• is not content-specific • requires a response that is likely to be the same from student to student • has boundaries set by the teacher.	• attempts to make connections to students' prior learning • is a "simplified" version of an "adult question" • requires some student involvement.	• seeks a limited extension of student knowledge and understanding • provides some opportunities for students to increase their understandings and competencies.	• suggests or hints at a real-world context • is connected to an aspect of adolescents' lives, although it may not be age-appropriate.	2

Open-ended	Relevant and engaging	Challenging and provocative	Significant	Level
The question:	The question:	The question:	The question:	
• is not content-specific • is "open" such as "how", "why" • is designed so that students can explore a variety of possibilities.	• assumes a degree of prior knowledge and experience • "hooks" student interest in an age-appropriate manner • is phrased in student-friendly language • provides ways for students to be actively involved.	• seeks to extend prior knowledge and understandings • provides for varied ways in which students can increase their understandings and competencies • could contain an unfamiliar big idea which requires "unpacking".	• is student centred • encourages students to consider the unit's big idea and to reflect on it in the context of their adolescent world.	3

Summative assessment

Summative assessment is the process of determining for each student a level of achievement in the assessment criteria. Teachers will bring together information they have on student learning to build a picture of where each student sits on the level of achievement scales.

Teachers are not confined to using just one assessment task in each MYP unit of work—they should use data taken from a range of assessments.

Culminating task

Teachers are required to develop a culminating assessment task for each MYP unit. A culminating task will provide students with further opportunities to demonstrate their learning in an authentic real-life situation.

Often a culminating task will allow students an opportunity to respond to the MYP unit question. However, it is critically important that teachers consider how students will be able to demonstrate their understanding of the significant concept or big idea at some point during the MYP unit of work, if not during the culminating task.

Teachers must think as assessors, asking themselves the following questions.

- "What will constitute acceptable evidence of understanding?"
- "How will students show what they have understood about the significant concept or big idea?"

Descriptor	Level
The culminating task is **content-based** and does **not** provide opportunities for students to demonstrate their understanding of the concept, skills and subject-specific knowledge.	0
The culminating task provides students with **limited opportunities** to demonstrate their understanding of the significant concept/big idea; the **emphasis** is on demonstrating developed skills and knowledge. The task requires students to use a **limited range** of approaches to learning skills and subject knowledge that have few connections with the objectives that frame the unit. Students are directed to communicate their learning in one way.	1
The culminating task allows students to demonstrate their understanding of the significant concept/big idea, although it may seem **prescriptive** and **restrict student options**. The task requires students to use skills, **some of which** may be represented in the objectives framed by the unit, and selected subject-specific knowledge. There is some choice in the way that students communicate their learning, although these may not align with the objectives.	2
The culminating task is **open-ended** and designed for students to demonstrate their understanding of the significant concept/big idea. The task allows students to use their developed approaches to learning skills that are aligned with the MYP objectives identified in stage 2 of the planner, and their specific-subject knowledge. The task provides multiple ways for students to communicate their learning and aligns with the MYP objectives that frame the unit.	3

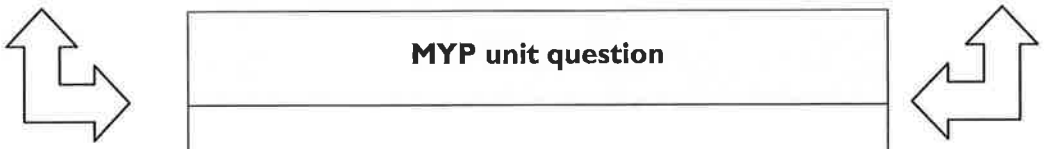
	Checklist to evaluate unit planners		
		yes	not really
	Purpose of the unit		
	Was the MYP unit question clearly stated?		
	Were appropriate connections made in the MYP unit question between the main concepts and an AoI?		
	Were the opportunities for inquiry appropriate for the development level and interests of the students?		
	Was there a direct link between the concepts to be understood and the learning activities?		
	Significant concepts in context		
	Did the unit of work provide opportunities for exploring significant knowledge?		
	Did the unit of work provide opportunities for understanding the main concepts and related concepts?		
	Did the unit of work provide opportunities for acquiring and applying relevant skills?		
	Did the unit of work provide opportunities for developing responsible attitudes and taking action?		
	Did the unit of work provide opportunities for engaging in ongoing and meaningful reflection?		
	Were the lines of inquiry and learning experiences drawn from a variety of cultural perspectives?		
	Assessment		
	Did the summative assessment link to the MYP unit question?		
	Did the assessment strategies and tools allow for differences in the way students learn?		
	Were the criteria for success in this unit of work clearly identified for both students and the teachers?		
	Learning experiences		
	Did the learning experiences stem from a variety of appropriate teaching strategies and learning needs?		
	Did the availability and range of resources support the inquiry for all students?		
	Were students actively engaged, provoked and challenged?		
	Was there space for student inquiry?		

MYP unit planner

Unit title	
Teacher(s)	
Subject and grade level	
Time frame and duration	

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus Which area of interaction will be our focus? Why have we chosen this?		**Significant concept(s)** What are the big ideas? What do we want our students to retain for years into the future?



MYP unit question

Assessment What task(s) will allow students the opportunity to respond to the unit question? What will constitute acceptable evidence of understanding? How will students show what they have understood?
Which specific MYP objectives will be addressed during this unit?
Which MYP assessment criteria will be used?

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills?

Learning experiences

How will students know what is expected of them? Will they see examples, rubrics, templates?

How will students acquire the knowledge and practise the skills required? How will they practise applying these?

Do the students have enough prior knowledge? How will we know?

Teaching strategies

How will we use formative assessment to give students feedback during the unit?

What different teaching methodologies will we employ?

How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice*.

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

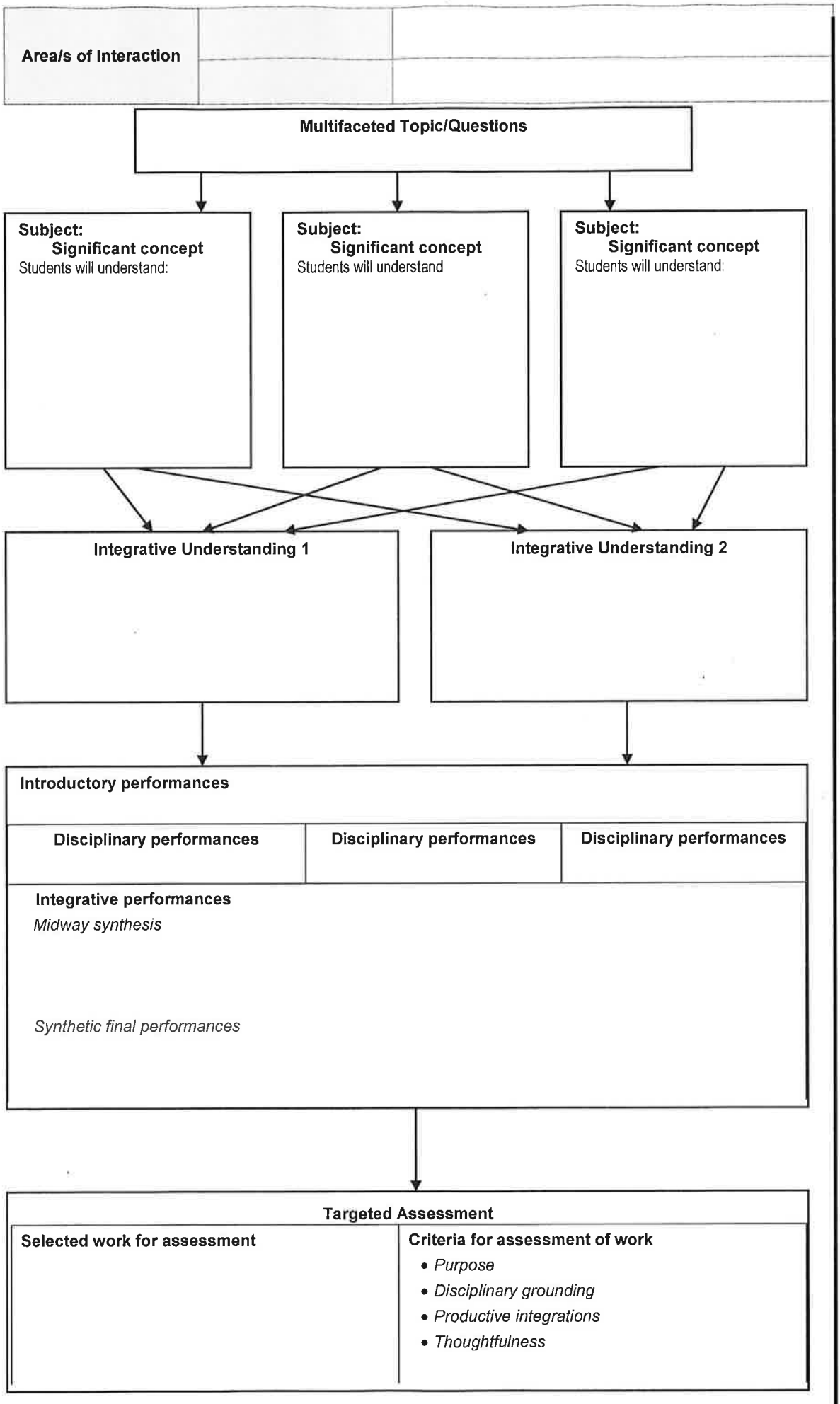
Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

Figure 12

MYP unit planner



Multifaceted topics *are...*
- *relevant*
- *feasible*
- *clearly framed*

Disciplinary Understandings *are...*
- *robust*
- *selective*

Integrative Understandings *are...*
- *tied to the purpose of the unit*
- *clearly described*

Performances of Understanding...
- *foster clarity of purpose, disciplinary grounding, productive integrations and thoughtfulness*
- *progressively advance interdisciplinary understanding of the topic*
- *take advantage of rich experiences and resources*

Targeted Assessment...
- *draws on a representative selection of student work*
- *is formative and summative*
- *pays attention to clarity of purpose, disciplinary grounding, productive integrations and thoughtfulness*

Year 3 Interdisciplinary Unit

Unit Question: How have patterns become a part of life?

This unit will cover the many uses of patterns in Mathematics, Science, US History and Language.

Objectives:

Language A: Students will discover that patterns of speech and body language can tell things like what part of the country or world you come from as well as whether you are being truthful or not. They will also learn that there are patterns we must follow when writing essays and citing sources.

Science: Scientists use patterns in their discoveries and experiments to save species and our environment, predict disease outbreaks and weather and much more.

Mathematics: Patterns lead to equations that can be used to do everything from predicting population growth and weather to determining insurance rates, how many portable classrooms will be needed next year and how many teachers need to be hired. Patterns found in nature give us the basis for our figures used in construction and architecture. Ideas about beauty come from how well things fit the patterns of symmetry and the golden ratio. It was the discovery of patterns that gave us the Pythagorean Theorem, musical notes, and even the number Pi.

Humanities: They will compare and contrast and look for similarities among things that happened during different time periods in history and if we are repeating those patterns today.

Art: Patterns are used in different artistic styles and periods in art history.

Music: Patterns are the basis for musical compositions.

Plan:

Each teacher will work within their subjects with different areas of interaction, subject specific guiding questions, and assessment.

Sample Unit Questions

Significant Concept: Finding similarities AOI: Human Ingenuity

How do you know when you can believe what you see?

Significant Concept: Complex begins with simplicity AOI: Human Ingenuity

Why do we break things down?

Significant Concept: The importance of precision for safety AOI: Health and Social

How do you know you are right?

Significant Concept: Getting from A to B AOI: Human Ingenuity

How do I measure the immeasurable?

Significant Concept: Process has purpose AOI: Human Ingenuity

How can you learn from your mistakes?

Significant Concept: Winning may be predictable but the cost may not.

AOI: Health and Social

What is the cost of playing games?

INTERDISCIPLINARY UNITS

Theme: beauty

Significant Concept: Definitions of beauty around the world AOI: H&S

What is beauty to me?

Theme: water

Significant Concept: Be aware of your own body as a precious genetic package

AOI: H&S

How can I measure my health?

Theme: renewable energy

Significant Concept: Everything uses energy AOI: Environments

How long can we keep going?

Theme: Nutrition

Significant Concept: Good life has balance AOI: H&S

How much is enough?

Theme: Technology

Significant Concept: The impact of technology on teens AOI: H&S

How does technology affect our lives?

MYP unit planner

Unit title	Get to the point!
Teacher(s)	
Subject and grade level	MYP 1
Time frame and duration	27 class periods

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus Which area of interaction will be our focus? Why have we chosen this?	Significant concept(s) What are the big ideas? What do we want our students to retain for years into the future?
Community and Service Individuals, communities and governments have to budget to meet a variety of needs.	***Everything has value.***

MYP unit question
Adult question: How do we know that everything has value? ***Student question: What is valuable to me?***

Assessment What task(s) will allow students the opportunity to respond to the unit question? What will constitute acceptable evidence of understanding? How will students show what they have understood?
A real-life problem: Students will use ads from a newspaper to budget, "go shopping", work out a total (including tax), and divide up remaining money evenly.
Which specific MYP objectives will be addressed during this unit?
(These specifically address the assessment task, not all of the assessments in the unit) **A:** Interim objective: Apply basic rules correctly to solve simple problems including those in real-life contexts. **D:** Interim objective: Consider the importance of their findings with guidance from the teacher.
Which MYP assessment criteria will be used?

Criteria A & D

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

Add decimals
Subtract decimals
Multiply decimals
Divide decimals
Solving problems

Listen and follow directions
Reflect on real-world math problems
Work with adding tax and tip on to a bill
Explain mathematical results for a real-world problem
Explore how decimals are used around the world
Investigate how money is valued around the world

Number Sense

- Calculate given percentages of quantities and solve problems involving discounts at sales, interest earned, and tips.
- Students calculate and solve problems involving addition, subtraction, multiplication, and division.

Mathematical Reasoning

- Use estimation to verify the reasonableness of calculated results.
- Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
- Express the solution clearly and logically by using the appropriate mathematical notation, terms and clear language; support solutions with evidence in both verbal and symbolic work.

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills?

***From MYP Objective:* Apply basic rules correctly to solve simple problems including those in real-life contexts.**

*Skill: application of mathematical rules regarding decimals and percents

***From MYP Objective:* Consider the importance of their findings with guidance from the teacher.**

*Skill: understanding and exploring how mathematical concepts have real-world applications

Learning experiences	Teaching strategies
How will students know what is expected of them? Will they see examples, rubrics, templates? How will students acquire the knowledge and practise the skills required? How will they practise applying these? Do the students have enough prior knowledge? How will we know?	How will we use formative assessment to give students feedback during the unit? What different teaching methodologies will we employ? How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?
Every culture experiences the task of budgeting, adding and subtracting prices with decimals, and	•Discuss approach - what does this mean? In small groups called "families".

counting money. Some cultures may not even use a dot as a decimal, but rather a comma.

This project will be done in parts.

- Students will first "go shopping" by picking out items in a newspaper ad to purchase. They will add up all their purchases to get a family total.
- Next, students will be assigned a family budget. They will have to subtract to find out how much they have left.
- Students will then divide up the remaining money amongst themselves evenly. They will spend ALL of the money – no more than $1.00 can be left over!
- Finally, students will add sales tax on to each of the items, to see the difference a sales tax makes to a total. They will have an opportunity to use a coupon to get certain percentages off of the items.

Throughout the unit the teacher will incorporate mini lessons on the value of each person's positive contributions to the community and translate them to show mathematical meaning. Using this data analysis, the students will promote awareness amongst student body in the form of "Did you know?" posters or slide show.

To assess each student individually, students will have an opportunity to recreate this type of project individually. Each student will buy food from menus, add up the total cost, including tax and tip, then find out how much money they have left over to divide up evenly among three friends.

•Independent work: based on learning in small groups

•**Skills**: Collaboration (group work)

Real-world application

Brainstorm

Mathematical rules/decimals/percentage

Exploring deeper connections between mathematical rules and real-world contexts

•**Activities**: Shopping in group on budget

Ordering at a restaurant/individually

Weekly quizzes

Daily homework

Pre/post mini assessment of understanding the relationship between value and decimals: Answer Unit Question first in individual brainstorm, then break into "families" to explain the relationship between value and decimals.

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Newspaper ads, writing materials, glue, paper, scissors, Math practice books to practice necessary skills, sample take-out menus, If the World was a Village book, What is a Million? book

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice*.

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

Students LOVED the real-world application, and the idea of "going shopping".

Adding the tax on at the end worked well to really show the impact of having to pay taxes, although getting to use coupons earlier during the project may have been more interesting for the students.

MYP unit planner

Unit title	**Oh why, oh why can't I?**
Teacher(s)	Bloch, Singer
Subject and grade level	Algebra, Year III (Eighth Grade)
Time frame and duration	3rd Quarter: Feb 14th - March 11 (4 weeks)

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus Which area of interaction will be our focus? Why have we chosen this?	**Significant concept(s)** What are the big ideas? What do we want our students to retain for years into the future?
Human Ingenuity Reflection upon how humans use models and formulae to explain the way things work.	There may be a difference between theory and reality.

MYP unit question

How can my ideas become real?

Assessment

What task(s) will allow students the opportunity to respond to the unit question?

What will constitute acceptable evidence of understanding? How will students show what they have understood?

Prescribed minimum task: Real-life problem

Culminating Task: You work for "Light up the Night" pyrotechnics company that designs rockets for fireworks shows in Britain. Your boss is very excited about a new rocket design that she wants to launch from the top of Tower Bridge in London for the Guy Fawkes Holiday fireworks. So, she gives you her specifications and asks you to verify them. Her specifications state that the rocket is to be launched from a platform built at a height of 48.75 meters on the Tower Bridge, and have an initial upward velocity of 105 meters per second. The specifications also state that the rocket is to be equipped with an altitude sensor that will detonate starburst displays at heights of 400, 500, 600, and 700 meters above sea level so that they can be seen from long distances.

Your boss wants you to verify how many firework displays her rocket design will have. She also wants to know what changes, if any, you would make to the given specifications to improve upon her design. You will need to provide her with a written explanation of how and why your results make sense, and the calculations to back it up. You will also need to provide a graphic depicting the pathway of the rocket she designed, labelled with the height and scheduled times of each firework display. If you suggest changes to improve her design, you will need another graphic that depicts what happens with the changes you've made (see rubric attached).

The boss will judge your evaluation of her design based on these criteria:

- How well you consider the reasonableness of all your calculations.
- Your attempt to explain how you used your calculations to determine whether your results make sense.

- How well you use mathematical language and different forms of representation.
- How well you communicate your reasoning completely and in a way that makes sense (your graphics, written statements, and calculations all tell a consistent story).

Students who score a 3 or above on both modified rubrics for C and D will demonstrate acceptable evidence of understanding.

Which specific MYP objectives will be addressed during this unit?

Communication in mathematics:

- Communicate a mathematical line of reasoning in solving simple problems using different forms of representation.
- Use different forms of mathematical representation (simple formulae, diagrams, tables, charts, graphs and models).

Reflection in mathematics:

- Consider the reasonableness of their results in the context of the problem and attempt to explain whether they make sense.

Which MYP assessment criteria will be used?

Criteria C: Communication in mathematics

Criteria D: Reflection in mathematics

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question? (A)

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1? (B)

(A) Students will use their knowledge of quadratic functions and how to solve them in the context of a vertical motion problem in order to respond to the unit question - How can my ideas become real?

(B) California state standards:

11.0 Students apply basic factoring techniques to second-and simple third-degree polynomials. These techniques include finding a common factor for all terms in a polynomial, recognizing the difference of two squares, and recognizing perfect squares of binomials.

14.0*Students solve a quadratic equation by factoring or completing the square.

19.0*Students know the quadratic formula and are familiar with its proof by completing the square.

20.0*Students use the quadratic formula to find the roots of a second-degree polynomial and to solve quadratic equations.

21.0*Students graph quadratic functions and know that their roots are the *x*-intercepts.

22.0 Students use the quadratic formula or factoring techniques or both to determine whether the graph of a quadratic function will intersect the x-axis in zero, one, or two points.

23.0* Students apply quadratic equations to physical problems, such as the motion of an object under the force of gravity.

* denotes key standards

The following essential understandings will be use to help develop the concept that "There may be a difference between theory and reality."

- that there are limitations to models
- that there can be real and imaginary mathematical solutions
- that mathematical models can be used to predict outcomes
- mathematic formulas can be used to solve real life problems
- that a negative value in the solution of a quadratic function can have a real-world significance.

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills?

Students will develop the following subject-specific skills:

Describe results (ATL domain: Communication)

Consider the reasonableness of their results in various contexts (ATL domain: Transfer)

Explain results in connection with real-life. (ATL domain: Transfer)

Communicating a mathematical line of reasoning with data that makes sense (ATL domain: Communication)

Communicating a complete line of reasoning (ATL domain: Communication)

Formulate displays of data to communicate a set of results. (ATL domain: Communication)

Learning experiences	Teaching strategies
1. How will students know what is expected of them? Will they see examples, rubrics, templates? 2. How will students acquire the knowledge and practise the skills required? How will they practise applying these? 3. Do the students have enough prior knowledge? How will we know?	1. How will we use formative assessment to give students feedback during the unit? What different teaching methodologies will we employ? How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?
1. Rubrics shared with students prior to assessments 2. Daily lessons and practice problems. Scaffold the ATL skills each day. Provide opportunities to describe, attempt to explain, and explain providing supporting details. Songs, hand motions. White board practice. Students will be asked to address the following factual, conceptual, and provocative questions: What is a quadratic function? What does it look like? (F) What does it mean to solve quadratic functions? How do I do that? What are the different methods I could use? How do I know when to use which method? (C) What does it mean to have a real solution? If we live in the real world, why do we need imaginary numbers? (C) Where does the quadratic formula come from? How does it work? (F) Why do I have to know where it came from?	1. We will use progress on problems to highlight thinking errors that need to be corrected. We will also clear up misunderstandings in description and explanation in all types of classroom activities: from daily warm-ups, to investigations of problem outcomes, to wrong answer analysis, to even white board practice, and unit test 2. District tests, unit tests, quizzes 3. Constructivism, collaborative learning, project-based learning, structured and guided inquiry, philosophical chairs and direct instruction. 4. EL strategies for oral rehearsal, total physical response, math songs, differentiated tasks based on learning goals are offered to special needs students.

How do I graph quadratic functions? (F) What do we use quadratic functions to model in the real world? (C) How does the vertical motion formula work? (F) If mathematical models have limitations, why use them? (P)) What happens when I use different starting heights and ask questions about time at different given heights of objects? (C) How can I find the height if I have the time? (F) How can I find the maximum or minimum height? (F) What are the limitations of models? (C) 3. Regular formative assessment via warm-ups, homework difficulties. District assessment will provide additional formative data as well as the unit test.	

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Textbook materials: McDougall-Littel Algebra 1 Concepts and Skills,

Other resources: Graphing calculators, Punchline, algebra tiles, teacher generated materials

Flexible Grouping in pairs and re-group in trios and groups of four as needed on a daily basis, even within class meetings to collaborate on descriptions and explanations.

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice*.

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning?

What, if any, extension activities arose? How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit?

What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit?

Data collection

How did we decide on the data to collect? Was it useful?

MYP unit planner

Unit title	Teenage nutrition
Teacher(s)	
Subjects	Year 1 MYP Science, P.E. and Maths
Time frame and duration	6 WEEKS

Stage 1: Integrate significant concept, area of interaction and unit question

Area of interaction focus	Significant concept(s)
Which area of interaction will be our focus? Why have we chosen this?	What are the big ideas? What do we want our students to retain for years into the future?
Health and Social Education Looking after ourselves and others involves making choices, having personal values and taking responsibility	Nutrition can affect (physical) performance

MYP unit question

How do I know it's the right choice?

Assessment

What task(s) will allow students the opportunity to respond to the unit question?

What will constitute acceptable evidence of understanding? How will students show what they have understood?

Ourselves and others—including personal values and taking responsibility

Summative assessment:

Integrative understanding:

- -Students will show understanding of the role of nutrition in sports and its impact on performance by making a sport nutrition guide for their school.

OR

- -Students will show understanding of the importance of a balanced diet by making healthy school menus and creating an awareness campaign to promote a 'Healthy Lifestyle'.

Maths, PE, Sciences: Make an interactive, visual model to reflect a proposal for a healthy, fun teenage day, taking into account everything learned (a play, an installation, an interactive art piece, a wiki, an online magazine, etc).

PE, Sciences, Maths: Make a nutrition guide for middle school athletes, which includes a healthy school menu that is 'nutritious and delicious' to be proposed to school authorities.

Both options involve students using the skills they've practised during the unit and they will use prompt

sheets to keep a diary or a blog to record the stages of the work. The models or campaigns will be presented to the group and the group will assess the strengths and challenges. The student will add the group's reflection to their production as a conclusion addressing the unit question

Which specific MYP objectives will be addressed during this unit?

- understand and comment on the language, content, structure, meaning and significance
- show awareness of the need for an effective choice of register suited to the audience in both oral and written communication
- communicate scientific information using appropriate modes of communication
- discuss and evaluate scientific information from different sources (Internet, newspaper articles, television, scientific texts and publications) and assess its credibility
- know and understand concepts, and demonstrate skills (ratios, proportions, percents,etc)
- communicate mathematical information using a range of languages
- select and use appropriate mathematical knowledge when investigating problems
- select and apply appropriate mathematical skills and techniques when investigating problems
- demonstrate an understanding of the various principles that contribute to fitness, and their importance in various contexts
- use their knowledge to analyse situations and solve problems
- communicate effectively, including verbal and non-verbal forms of communication

Which MYP assessment criteria will be used?

Interdisciplinary criteria:

Clarity of purpose

Disciplinary grounding

Integration

Reflection

Specific-subject criteria addressed:

P.E.:

Criterion A: Use of knowledge

Criterion D: Social skills and personal engagement

Sciences:

Criterion B: Communication in science

Criterion C: Knowledge and understanding of science

Mathematics:

Criterion A: Knowledge and understanding

Criterion B: Investigating patterns

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

Knowledge:

- Leading a healthy lifestyle
- What's in food? Carbohydrates, proteins, vitamins, minerals, fats, etc
- Teenage nutrition, dietary guidelines, food pyramid, nutritional values, calories
- Ratios, proportions, percents
- Digestive system, metabolism
- Exercise, diets for improving physical performance

Skills:
Students will demonstrate within and integrate across all content areas the ability to:

- comprehend and evaluate written, visual and oral presentations and works
- evaluate the accuracy of information and the reliability of its sources
- organize data, information and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation
- apply acquired information, ideas and skills to different contexts as students, workers, citizens and consumers
- focus the application of skills on real-life experiences and help students develop lifelong learning skills
- analyse the duties and responsibilities of individuals in societies
- identify and apply practices that preserve and enhance the safety and health of self and others

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills?

Organization: time management: adhering to deadlines; self-management: personal goal setting, taking on responsibility

Communication: using appropriate structures and vocabulary to communicate their message:

Students will demonstrate within and integrate across all content areas the ability to:
- plan and make written, oral and visual presentations for a variety of purposes and audiences
- review and revise communications to improve accuracy and clarity
- exchange information, questions and ideas while recognizing the perspectives of others
- present perceptions and ideas regarding works of the arts and sciences
- use technological tools to exchange information and ideas

Reflection: self awareness

Thinking: brainstorming, planning, inquiring, questioning information

Transfer: make connections between the real world, transfer information using an interactive representation by building a metaphorical model

Learning experiences	Teaching strategies
How will students know what is expected of them? Will they see examples, rubrics, templates?	How will we use formative assessment to give students feedback during the unit?

How will students acquire the knowledge and practise the skills required? How will they practise applying these? Do the students have enough prior knowledge? How will we know?	What different teaching methodologies will we employ? How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?
Students will get examples and rubrics of the work expected (teacher and/or student generated). **Introductory performance:** Through a video clip on teenage body-image distortion and class discussion students share their views about what a healthy teenage diet is. They brainstorm on the causes and consequences of eating disorders, fast food and healthy lifestyle. They will acquire the knowledge and skills through a variety of performances of understanding that address the unit question. **Midway synthesis:** Students create three healthy teenage school menus catering for special diets such as: vegetarian, diabetics and gluten free. **Midway synthesis:** Students develop a school sport nutrition guide draft and interview two doctors and two athletes to get overall feedback and include their input in the school guide. **Midway synthesis:** Students determine the relationship between food intake and activity based on the 'energy expenditure chart'. They are going to make a plan of how to burn 1,000 calories in one day, using at least eight different activities from the chart. Students will need to figure out the activity, duration of activity, and the calories burned. Then they add up the calories and discussions will follow regarding what they noticed about the calories burned and the activities. Then they will develop two teenage school healthy sport days proposing some activities and accompanied by the recommended healthy two-day menus taking into account the calories count. Other performances of understanding to include if needed: <u>Media stereotypes</u>: How differences divide Students will make group collages and then compare them to discuss the values and lifestyles represented. <u>Graphing a healthy lifestyle</u> Survey a school class, graph the survey results and then compare them to your peers' in order to map out the whole school lifestyle. Decide how you will present the findings in a creative, effective way to the school community together with a healthier proposition. <u>Colour my numbers competition</u> Students devise as many healthy diets as they can by combining the right portions and different colours of the food pyramid and keeping to the dietary guidelines for teenagers. Present it to the class through a PowerPoint and two healthy options will be chosen. <u>A smart healthy school menu</u> After a survey and exploring about different	Formative assessment feedback will be provided throughout the unit by listening to the students share their interactions, discuss the main issues, share their family tree, blogs and presentations. All learning styles will be catered for. The activities will be balanced (visual, auditory and kinaesthetic) so as to appeal to all the students, and visual cues of the model, collage, etc. will also be provided. Differentiated learning will take place. For those students who have difficulties the degree of challenge of the activities will vary in the depth of their research, the explanation of their visual model, etc. Students will also be offered instruction about how to produce an effective guide, a presentation and given advice about suitable techniques to use for the model, the collage, etc.

'teenage menus', students reflect on their food choices and their group of friends and then the two selected options must be voted through a healthy food campaign election among their peers. **Final synthesis:** Students develop a healthy eating awareness campaign promoting the school 'Healthy Lifestyle' proposal (teenage menus and the sport nutrition guide).	

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

Free-standing boards to brainstorm, graph etc.

Access to computers/laptops for research, to prepare their activities, register the blogs or log books.

Web sites to be used:

for audio material

http://healthymeals.nal.usda.gov

www.nutrition.gov

http://www.medialit.org/focus/sci_home.html

http://www.uen.org/cc/uen/core/pub/displayCoreCourse.action?ccId=7710

http://www.uen.org/cc/uen/core/pub/displayCoreCourse.action?ccId=7100

http://www.uen.org/Lessonplan/LPview?core=7

http://www.uen.org/Lessonplan/preview.cgi?LPid=66

http://www.uen.org/Lessonplan/preview.cgi?LPid=103

www.eatright.org

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice*.

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

Are we prepared for the next stage?

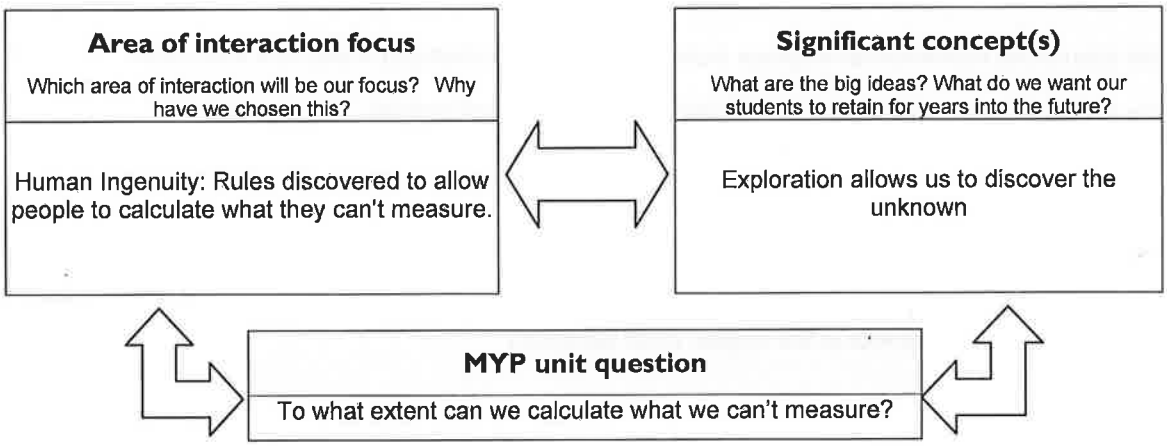
Data collection

How did we decide on the data to collect? Was it useful?

MYP unit planner

Unit title	Trigonometry
Teacher(s)	
Subject and grade level	Mathematics - MYP5
Time frame and duration	10 to 12 lessons

Stage 1: Integrate significant concept, area of interaction and unit question



Assessment What task(s) will allow students the opportunity to respond to the unit question? What will constitute acceptable evidence of understanding? How will students show what they have understood?
Topic test including basic skills and operations and including real-life problems about tide modelling. Investigating patterns: the cosine rule Reflection in Mathematics: the height of a building Reflection in Mathematics: modelling the relationship between time and height of water in Australia
Which specific MYP objectives will be addressed during this unit?

A Knowledge and understanding

Know and demonstrate understanding of the concepts from the branches of mathematics (number, algebra, geometry and trigonometry)
Use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts
Select and apply general rules correctly to solve problems including those in real-life contexts

B Investigating patterns

Select and apply appropriate inquiry and mathematical problem-solving techniques
Recognise patterns
Describe patterns as relationships or general rules
Draw conclusions consistent with findings
Justify or prove mathematical relationships and general rules

C Communication in Mathematics

Use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations
Use different forms of mathematical representation (formulae and models)
Move between different forms of representation

D Reflection in Mathematics

Explain whether their results make sense in the context of the problem
Explain the importance of their findings
Justify the degree of accuracy of their results where appropriate
- Suggest improvements to the method when necessary

Which MYP assessment criteria will be used?

A, B, C and D

Stage 2: Backward planning: from the assessment to the learning activities through inquiry

Content

What knowledge and/or skills (from the course overview) are going to be used to enable the student to respond to the unit question?

What (if any) state, provincial, district, or local standards/skills are to be addressed? How can they be unpacked to develop the significant concept(s) for stage 1?

- Sine rule
- Cosine rule
- Applying sine rule to solve advanced angle of elevation and depression problems
- Applying cosine rule to solve bearing problems
- Applying transformations to sine function
- Modelling tide using sine function

Approaches to learning

How will this unit contribute to the overall development of subject-specific and general approaches to learning skills?

- Knowledge-acquisition skills: understanding of mathematical concepts and ideas
- Problem-solving skills: mathematical strategies to solve problems in familiar and unfamiliar situations, in both mathematical and real-life contexts
- Communication skills: oral and written skills using mathematical language, symbols and notation, and a range of forms of representation (graphs)
- Thinking skills: coherent logical and abstract thinking, inductive and deductive reasoning, justification and proof, estimation and accuracy
- Collaborative skills: the ability to work as a team member, listening and interacting with others, respecting and considering different points of view
- Reflection skills: evaluation of one's own work and performance, identifying personal strengths and weaknesses to improve learning

Learning experiences	**Teaching strategies**
How will students know what is expected of them? Will they see examples, rubrics, templates?	How will we use formative assessment to give students feedback during the unit?
How will students acquire the knowledge and practise the skills required? How will they practise applying these?	What different teaching methodologies will we employ?
Do the students have enough prior knowledge? How will we know?	How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?

- Students will find they need to learn about trigonometry to be able to solve real-life problems which will help in enhancing their **meaning given motivation**. - Students will solve real-life problem to **apply learning**. - **Co-operative learning**: By working in groups they will interact to share ideas and strategies. - **Differentiated** homework enables students to reach different levels depending on their capabilities and interests. - Working in a competitive environment will make for **stimulating motivation**. - Students will solve the investigation, including in an unfamiliar situation, to enhance their thinking skills. - Students will use the stick and scrolled paper method to calculate the height of the building to **apply learning**. - Students will solve a reflection-in-Mathematics task to **enhance their insight** into Mathematics and make more sense of results. - Students will take notes to enhance their note-taking skills. - Students will brainstorm to enhance their thinking skills. - By completing the class sheets and daily homework students will master their learning (**Mastery learning**). - Students will produce a reflection after the test to consolidate the concepts learned.	**[General note: The lessons below are just a preliminary plan. Depending on the students interactions and interests, changes should be made to allow students to relate to the content]** **Lesson 1** - Start the unit with the opening problem from a real-life example of having 2 angles and one side (Calculating the height of Barlief hill from the other side of Suez canal). - Knowing 2 angles and one side of a triangle, ask students to calculate the length of another side of the triangle (students will work in groups and compete to see who will be able to calculate the length first. They will make the necessary constructions to be able to make the calculations). - Give two levels of homework. **Lesson 2** - Class sheet from Oxford Dr. Rayner book. Students solve in pairs as a competition until reaching the top of the ladder. - Homework: Investigation task: Cosine rule **Lesson 3** - Environmental education activity: calculate the height of the school building from the playground in groups of 4 (each having a role and hence differentiated instructions). - Homework: Reflection task about calculating the height of a four-storey building. **Lesson 4** - Discuss the cosine rule and its applications in real-life problems. - [Mastery] Different problems with different levels solved in groups of 4. - Give related homework. **Lesson 5** - Test Criteria A and C, including in unfamiliar situations. Students will then receive feedback and will be asked to reflect on their performance and understanding.
Learning experiences How will students know what is expected of them? Will they see examples, rubrics, templates? How will students acquire the knowledge and practise the skills required? How will they practise applying these? Do the students have enough prior knowledge? How will we know?	**Teaching strategies** How will we use formative assessment to give students feedback during the unit? What different teaching methodologies will we employ? How are we differentiating teaching and learning for all? How have we made provision for those learning in a language other than their mother tongue? How have we considered those with special educational needs?

- **Technology in education:** Use of Ti-84 as a graphing tool will make students see how technology can help. - Students will find they need to learn about trigonometry to be able to solve real-life problems which will help in enhancing their **meaning given motivation**. - Students will search for data, including wave heights from a bay in Australia, to enhance their literacy skills. - Students will take notes and compare models from different places in the world to consolidate the unit concepts and work on their international-mindedness. - Students will participate in making the unit summary and take notes on it to differentiate between concepts and skills in the unit, and to make sure concepts are clear. - Students will think about whether trigonometry is an invention or discovery to enhance their **thinking skills**. - Students will produce a reflection on their performance after the test to enhance the attribute "**reflective**" and consolidate the unit concepts.	**Lesson 6** - **Technology in education:** plot the sine function manually then check the shape using Ti 84 as a graphing tool. - Homework: apply transformations on sine function. **Lesson 7** - Discuss parameters and apply to heights of waves in Abu Kir.(http://iodeweb1.vliz.be/odin/bitstream/1834/1449/1/Text.3.pdf) from EGYPTIAN JOURNAL OF AQUATIC RESEARCH **Vol. 32 No. 1**, 2006: 22-33. - Homework: Find data from bay in Australia and compare. **Lesson 8** - Discuss differences in parameters between the two models. - Give class sheet from Questionbank. The rest of sheet to be solved at home as homework. **Lesson 9** - Wrap-up the unit with a summary elicited from students. - Discussion about the question: Is trigonometry a discovery or an invention? On another planet will trigonometry exist? What will it look like? **Lesson 10** Test Criteria A and C including in unfamiliar situations. Student will then receive feedback and will be asked to reflect on their performance and understanding.

Resources

What resources are available to us?

How will our classroom environment, local environment and/or the community be used to facilitate students' experiences during the unit?

- School building and playground used in the activity
- Use of Internet to search for data
- Books:

Oxford Mathematics for Standard level

Oxford Dr Rayner

For practising on real-life problems: Haese and Harris MYP5

IB Questionbank

Ongoing reflections and evaluation

In keeping an ongoing record, consider the following questions. There are further stimulus questions at the end of the "Planning for teaching and learning" section of *MYP: From principles into practice*.

Students and teachers

What did we find compelling? Were our disciplinary knowledge/skills challenged in any way?

What inquiries arose during the learning? What, if any, extension activities arose?

How did we reflect—both on the unit and on our own learning?

Which attributes of the learner profile were encouraged through this unit? What opportunities were there for student-initiated action?

Possible connections

How successful was the collaboration with other teachers within my subject group and from other subject groups?

What interdisciplinary understandings were or could be forged through collaboration with other subjects?

Assessment

Were students able to demonstrate their learning?

How did the assessment tasks allow students to demonstrate the learning objectives identified for this unit? How did I make sure students were invited to achieve at all levels of the criteria descriptors?

Are we prepared for the next stage?

Data collection

How did we decide on the data to collect? Was it useful?

International Baccalaureate

What are the responsibilities of the designer?

Topic 6

International Baccalaureate

Unpacking Activity

- How many objectives are there?
- Name the five branches in MYP Mathematics
- What is the minimum teaching hours required?
- How many levels of Mathematics can be offered? What are they?
- Does MYP Mathematics provide for special needs students?

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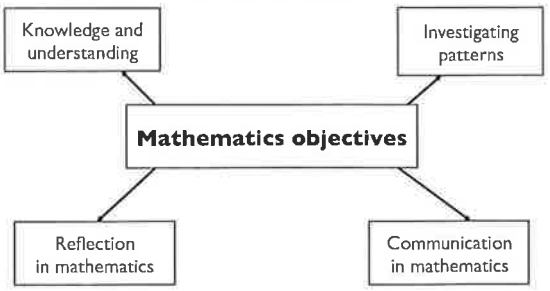
Mathematics objectives



A - Knowledge and understanding

- Know and demonstrate understanding of the concepts from the five branches of mathematics.
- Use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations, including those in real-life contexts.
- Select and apply general rules correctly to solve problems, including those in real-life contexts.
- **Assessment tasks** are likely to be class tests, examinations, real-life problems and investigations.

B - Investigating Patterns

- Select and apply appropriate inquiry and mathematical problem-solving techniques.
- Recognize patterns.
- Describe patterns as relationships or general rules.
- Draw conclusions consistent with findings.
- Justify or prove mathematical relationships and general rules.
- **Assessment tasks** should be mathematical investigations of some complexity.
- Teachers should clearly state whether the student has to provide a justification or proof.

C - Communication in mathematics

- Use appropriate mathematical language (notation, symbols and terminology) in both oral and written explanations.
- Use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- Move between different forms of representation.
- **Assessment tasks** are likely to be real-life problems, tests, examinations and investigations.

D - Reflection in mathematics

- Explain whether his/her results make sense in the context of the problem.
- Explain the importance of his/her findings in connection to real life.
- Justify the degree of accuracy of his/her results where appropriate.
- Suggest improvements to the method when necessary.
- **Assessment tasks** are most likely to be investigations and real-life problems.

Search, find and unpack...

- Find the list of **minimum prescribed tasks** for mathematics in your subject guide
- As a group, **discuss** these tasks to unpack what they mean, and **describe** what each looks like
- **List** examples from your own practice that might apply. Be prepared to share with the group

Which Minimum Assessment Task?

- Broad-based classroom test/exam: familiar and unfamiliar situations, cover **at least three branches** of the framework (Criterion A)
- Mathematical investigation: test conditions, opportunity to recognize patterns, describe them as relationships or rules and justify or prove them (Criterion B)
- Real-life problem: students have the opportunity to apply math to a real-life context, reflect upon and evaluate their findings (Criterion D)

Question...

Why are the prescribed minimum tasks so important when there are so many possible tasks?

Designers task...

- Design an end-of-unit assessment task using the prescribed minimum. Be sure to include depth and complexity in the task

G.R.A.S.P.S. Performance Task Scenario

- G = Goal
- R = Role
- A = Audience
- S = Situation
- P = Product/Performance and Purpose
- S = Success (Criteria for)

(refer to workbook template)

Assessment

What task(s) will allow students the opportunity to respond to the unit question?

What will constitute acceptable evidence of understanding? How will students show what they have understood?

Which specific MYP objectives will be addressed during this unit?

Which MYP assessment criteria will be used?

Assessment

What task(s) will allow students the opportunity to respond to the unit question?

What will constitute acceptable evidence of understanding? How will students show what they have understood?

Prescribed minimum task: Real-life problem

Culminating task: Student will have a set amount of money for their household budget and be asked to "go shopping" and stay within their budget. Students will work out a total spent (including taxes if applicable)

Display: The unit you are designing

Include: Unit title and Year
Significant Concept
AoI
Unit Question
Assessment Task (including objectives)

Evaluate: "Evaluating Unit Planners"

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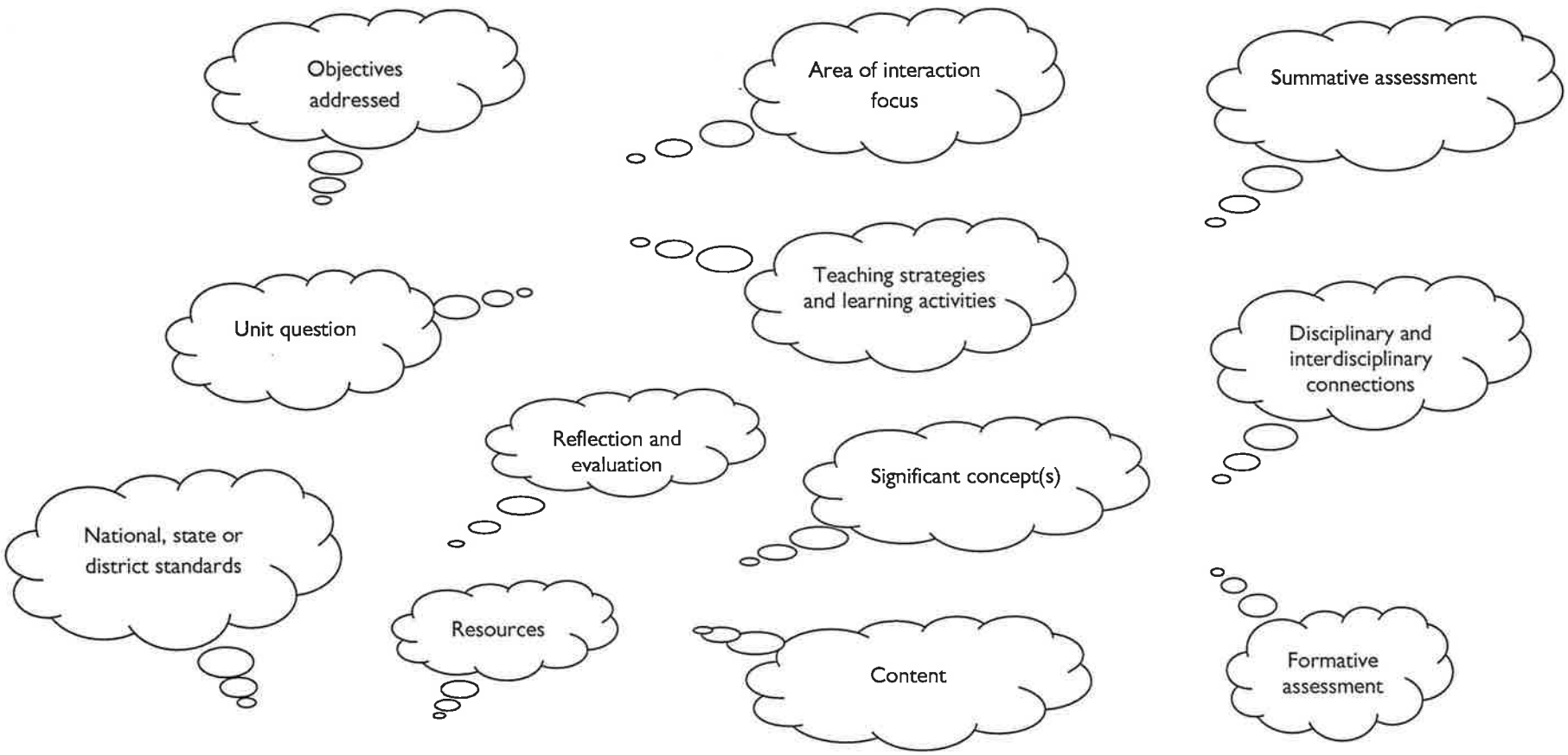
What should go into an MYP unit plan?



Performance Tasks (Complete a Performance Task blueprint for each task)
Summary in GRASPS form

Goal

Your task is

The goal is to

The problem or challenge is

The obstacles to overcome are

Role

You are

You have been asked to

Your job is

Audience

Your clients are

The target audience is

You need to convince

Situation

The context you find yourself in is

The challenge involves dealing with

Product, Performance, and Purpose

You will create a
in order to

You need to develop
so that

Standards and Criteria for Success

Your performance needs to

Your work will be judged by

Your product must meet the following standards

http://www.burlingtonk12.org/high_school_web/html/ubd_stg3_learningplan11.pdf

What is a Performance Task?

A performance task is a complex scenario that provides students an opportunity to demonstrate what they know and are able to do concerning a given concept. The components of the framework for the performance task are outlined in the acronym **GRASPS**. The ***goal*** states the purpose of the task; the ***role*** explains student involvement in the scenario; the ***audience*** identifies the people the students address; the ***situation*** explains the scenario; the ***product*** is the tangible evidence of student understanding; and the ***standards/criteria*** describes how students can complete the task successfully.

GRASPS: Outlining the Performance Task

Goal • Provide a statement of the task. • Establish the goal, problem, challenge, or obstacle in the task.	
Role • Define the role of the students in the task. • State the job of the students for the task.	
Audience • Identify the target audience within the context of the scenario. • Example audiences might include a client or a committee.	
Situation • Set the context of the scenario. • Explain the situation	
Product • Clarify what the students will create and why they will create it.	
Standards and Criteria • Provide students with a clear picture of success. • Identify specific standards for success. • Issue rubrics to the students.	

PERFORMANCE TASK DETAILS

http://ritter.tea.state.tx.us/ssc/downloads/toolkits/Shared%20Sections/Understanding%20By%20Design/UBD%20Template.pdf

Assessment

Culminating task

Teachers are required to develop a culminating assessment task for each MYP unit. A culminating task will provide students with further opportunities to demonstrate their learning in an authentic situation.

A culminating task will allow students an opportunity to respond to the MYP unit question. It is critically important that teachers consider how students will be able to demonstrate their understanding of the significant concept or big idea.

Teachers must think as moderators, asking themselves the following questions.

"What will constitute acceptable evidence of understanding?"

"How will students show that they have engaged with the unit question and significant concept?"

"How will students show what they have understood about the significant concept or big idea?"

When teachers are in stage 1 of the planner, assessment is the process of determining for each student a level of achievement in the assessment criteria. Teachers will bring together information they have on student learning to build a picture of where each student sits on the level of achievement scales. Teachers are not confined to using just one assessment task in each MYP unit of work—they should use data taken from a range of assessments.

Descriptor	Level
The culminating task does **not** provide opportunities for students to **engage** with the unit question and significant concept embedded in it and to demonstrate their understanding of the concept, skills and subject-specific	0

knowledge.	
The culminating task provides students with **limited opportunities** to demonstrate their understanding of the significant concept and respond to the unit question; the **emphasis** is on demonstrating developed skills and knowledge only. Students are directed to communicate their learning in one way. The task requires students to use a **limited range** of approaches to learning skills and subject knowledge that have few connections with the objectives that frame the unit.	1
The culminating task allows students **some** opportunities to demonstrate their understanding of the significant concept and respond to the unit question, although it may seem **prescriptive** and **restrict student options**. The task requires students to use approaches to learning skills and selected subject-specific knowledge, **some of which** may be represented in the objectives framed by the unit.	2
The culminating task is **open-ended** and designed for students to demonstrate their understanding of the significant concept and respond to the unit question. The task gives students the opportunity to communicate approaches to learning skills developed and objectives reached through the unit, as well as subject-specific knowledge identified in stage 2 of the planner.	3

References

Erickson, HL. 2008. *Stirring the Head, Heart, and Soul*. Corwin Press, USA.

Wiggins, G and McTighe, J. 1998. *Understanding by Design*. Association for Supervision and Curriculum Development. 0-87120-313-8.

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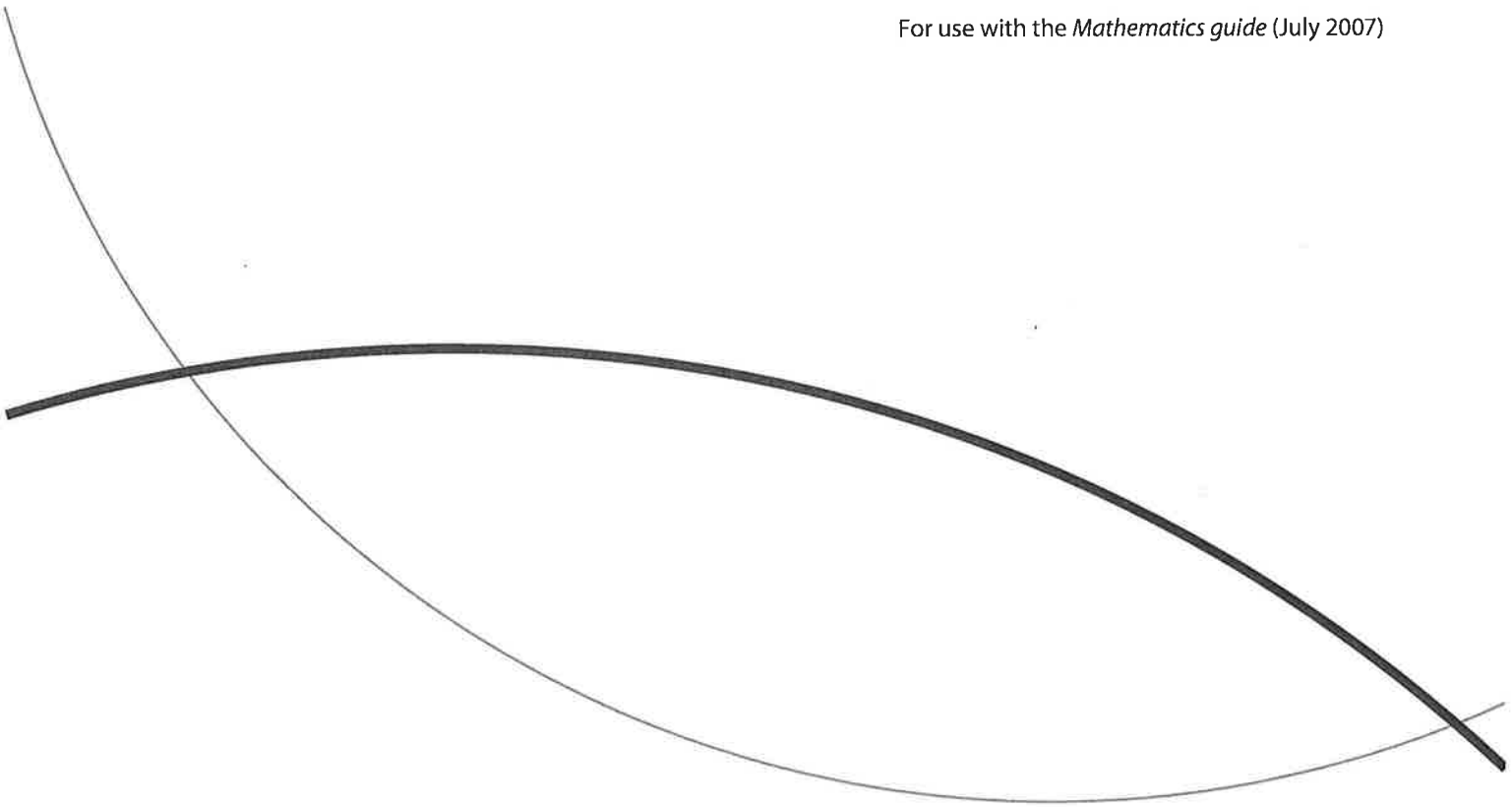
Middle Years Programme

Mathematics teacher support material
Example interim objectives

For use with the *Mathematics guide* (July 2007)



Objectives for years 1, 3 and 5 of the Middle Years Programme

Year 5 objectives

The mathematics objectives for year 5 of the Middle Years Programme (MYP) are already in place and can be found in the *Mathematics guide* (July 2007). This set of **prescribed** objectives forms the basis for the **assessment criteria**, also published in the guide, which must be used for final assessment of students' work during year 5.

Example interim objectives

Example interim objectives for years 1 and 3 of the MYP appear in the tables that follow. They have been developed in order to:

- promote articulation between the MYP and the Primary Years Programme (PYP)
- support individual schools in developing a coherent curriculum across the five years of the programme (or however many years a school is authorized to offer)
- emphasize the need to introduce students to the required knowledge, understanding, skills and attitudes from the first year of the programme
- provide examples of possible learning experiences that will allow students to work towards meeting the final objectives for year 5
- support schools that are authorized to offer the first three years of the MYP in designing appropriate assessment tasks for the end of the third year.

Unlike the objectives for year 5, the interim objectives for years 1 and 3 are not prescribed, although the IB recommends that all schools use them. Schools may choose to adopt the objectives contained in this document or develop their own.

If choosing to develop their own interim objectives, schools must start with the prescribed objectives for year 5 and modify each one by taking into account the age, prior knowledge and stage of development of students in an earlier year of the programme. Each year 5 objective will then correspond directly to a modified objective in a preceding year of the programme. **No objectives should be omitted** from a previous year as it is vital to ensure a coherent progression of learning across all five years of the programme.

MYP units of work

Examples of possible learning experiences, each aligned to an objective, appear in the tables that follow. Each learning experience is intended to form part of a larger unit of work designed to address a central question or theme, known as the **MYP unit question**. More information about MYP units of work can be found in the section on "Planning for teaching and learning" in *MYP: From principles into practice* (August 2008).

Within each unit of work, the **context for learning**, **significant concept(s)** and **assessment tasks** are defined in relation to the MYP unit question. The areas of interaction provide the context for learning while the significant concepts refer to the underlying concepts that define the principal goal of the unit. Assessment tasks are designed to address the levels of students' engagement with the MYP unit question and the aligned objectives.

Context for learning

Every MYP unit of work has an approaches to learning (ATL) component: a shared and agreed set of skills that all teachers develop with their students throughout the entire programme. The context that frames a particular unit of work is generally derived from one of the other four areas of interaction, although ATL might be the specific context on some occasions. Some of the examples of learning experiences listed in the tables that follow have an obvious connection to one of the areas of interaction, for example, investigating the relationship between the volume of air in a classroom (and other enclosed spaces) and the health requirements of each student. Other connections may become clear only after a more considered approach but teachers should be able to establish these connections for their own students within each MYP unit of work.

Several examples of learning experiences listed also strongly suggest the possibility of planning an interdisciplinary unit in collaboration with other subject teachers, for example, representing Newton's laws of motion as algebraic equations, tables and graphs using data that has been generated and data that has been collected experimentally.

Assessment tasks

One of the first stages in planning a unit of work is to design **summative assessment tasks**, linked to the MYP unit question, which provide varied opportunities for students to demonstrate their knowledge, understanding, skills and attitudes. It is also important to include ongoing **formative assessment tasks** within a unit of work as these provide valuable insights into the extent of student learning as the unit of work progresses.

It is important to realize that the formats of both summative and formative assessment tasks need not be reduced to examinations, tests, quizzes and written questions set as homework. These formats are valid in certain cases but do not always take into account different learning styles and may not provide students with sufficient creative scope to demonstrate all they have learned. There are many different ways in which evidence of student learning can be found. For example, students could carry out assessment tasks that involve:

- making a presentation using visual aids (for example, flipcharts, electronic slides)
- solving a cross-number puzzle where the clues are provided in the form of calculations to be made and/or problems to be solved
- playing a game that requires a particular set of skills or knowledge and understanding of certain concepts
- making a three-dimensional model (for example, scale models of the earth, moon and sun)
- telling a story (for example, stories where numbers have been deliberately scaled up or down by multiples of ten to provide comic entertainment, thereby demonstrating the need for accuracy with regard to place value)
- keeping a personal journal that documents their development of mathematical understanding
- making a poster or wall chart
- writing a short song or poem that incorporates important mathematical principles (for example, a rap chant incorporating the principles of Pythagoras' theorem)
- creating a mnemonic as an aid to memory (for example, the rules for the sine, cosine and tangent properties of a right-angled triangle expressed in one word, SOHCAHTOA, or as a phrase or saying, "**S**ome **o**wls **h**ave ….")
- keeping a scrapbook containing extracts from the media that illustrate a particular property
- maintaining a folder of their own work
- developing an information booklet/leaflet that describes a concept and/or mathematical process in detail
- writing a summary sheet as a revision guide for a particular mathematical topic
- creating pictures, diagrams or cartoons to illustrate a particular concept or process
- carrying out an investigation
- collecting data and storing it in appropriate formats (for example, tables, spreadsheets)
- creating a personal data booklet.

Tables of objectives

A Knowledge and understanding

Knowledge and understanding are fundamental to studying mathematics and form the base from which to explore concepts and develop problem-solving skills. Through knowledge and understanding students develop mathematical reasoning to make deductions and solve problems.

Year 1	Year 3	Year 5
Objectives		
At the end of the first year, students should be able to demonstrate basic knowledge and understanding of the following branches of mathematics: • number • algebra • geometry and trigonometry • statistics and probability • discrete mathematics by being able to:	At the end of the third year, students should be able to demonstrate some knowledge and understanding of the following five branches of mathematics: • number • algebra • geometry and trigonometry • statistics and probability • discrete mathematics by being able to:	At the end of the course, students should be able to demonstrate knowledge and understanding of the following five branches of mathematics: • number • algebra • geometry and trigonometry • statistics and probability • discrete mathematics by being able to:
• know and demonstrate understanding of some of the basic concepts of number, algebra, geometry and trigonometry, statistics and probability, and discrete mathematics	• know and demonstrate understanding of some of the concepts of number, algebra, geometry and trigonometry, statistics and probability, and discrete mathematics	• know and demonstrate understanding of the concepts from the five branches of mathematics (number, algebra, geometry and trigonometry, statistics and probability, and discrete mathematics)
• use basic concept-specific strategies to solve simple problems in both familiar and unfamiliar situations including those in real-life contexts	• use appropriate mathematical concepts and skills to solve simple problems in both familiar and unfamiliar situations including those in real-life contexts	• use appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts
• apply basic rules correctly to solve simple problems including those in real-life contexts.	• select and apply basic rules correctly to solve problems including those in real-life contexts.	• select and apply general rules correctly to solve problems including those in real-life contexts.
Examples of possible learning experiences		
Number Students could: • find data in newspapers and classify it as discrete or continuous • classify numbers as natural, odd, even, square and/or triangular • use the Sieve of Eratosthenes to find prime numbers less than 100	**Number** Students could: • make a geological time line on the wall of the classroom • investigate the relationship between the volume of air in a classroom (and other enclosed spaces) and the health requirements of each student	**Number** Students could: • compare the number of kilometres per litre of fuel per passenger used by planes, trains, buses and/or cars • explore the history and significance of irrational numbers and identify some of the symbols used for particular irrational numbers, for example, π (pi), e (Euler's number), φ (the golden ratio).

- count very large sets of objects (coins, cars passing, people in a large space, numbers) to emphasize the importance of organization and grouping
- make a time line on the wall of the classroom emphasizing dates of important mathematicians and mathematical discoveries.

Algebra

Students could:

- use a pan balance to simulate the addition or subtraction of like quantities from both sides of an equation by keeping the pans balanced
- use the balance model to create equations for classmates to solve
- create pictures on squared paper and provide a list of coordinates for classmates to construct the picture by joining the points in order
- create a booklet containing information on algebra topics (explanations, examples and exercises) for use by subsequent students.

Geometry and trigonometry

Students could:

- investigate the sum of the interior angles of triangles and quadrilaterals by drawing and cutting out different shapes on paper, tearing off the angles and fitting them together to form straight lines and/or circles
- investigate the tangent ratio by comparing students' heights with the lengths of their shadows
- investigate reflections by using a mirror to reflect faces along different centre lines.

Statistics and probability

Students could:

- find the ranges and means of leaf lengths on two trees of the same species but located in different environments (sun and shade).
- investigate rounding numbers to a specified number of significant figures by considering the accuracy of measurements in real life, such as the length of a 100 m athletics track, the extent of possible errors and the impact these may have.

Algebra

Students could:

- generate a series of ordered pairs by substituting values in a linear equation and have classmates identify patterns and/or work out the formula
- find a rule for the number of 1 cm squares needed to put a 1 cm-wide frame around a square picture whose side is n cm.

Geometry and trigonometry

Students could:

- draw or construct a model of an appropriate building (the school or their own house) by piecing together rectangular or triangular prisms only
- estimate the volumes of irregular solid objects as the sum of more simple approximated shapes and verify their results by immersing each object in water and measuring the displaced volume
- investigate the underlying patterns and constructions evident in particular designs and/or artworks, for example, traditional Moroccan designs, and then create their own tessellated designs
- use Pythagoras' theorem and the trigonometric ratios as tools for measuring large-scale objects and/or distances in open spaces.

Statistics and probability

Students could:

- design statistical surveys to investigate health and social education issues, with guidance from the teacher
- construct a tree diagram for a three-day weather forecast where the probability of rain on any day is estimated from past data
- compare the lengths of words and/or sentences in texts aimed at different readerships.

Algebra

Students could:

- show that the ratios of successive terms of a Fibonacci sequence (u_n / u_{n+1}) converge to the same value regardless of the term chosen as u_1
- find the best angle for throwing a basketball so that it will go in the basket from the free throw line, by modelling its trajectory graphically using their knowledge of quadratic equations
- investigate exponential growth in a biological population.

Geometry and trigonometry

Students could:

- use the unit circle as a physical tool to calculate the values of different trigonometric ratios (in order to appreciate the circular nature and symmetry of each function, and the significance of the asymptotes in the tangent function)
- use the transformations of translation, reflection, rotation, enlargement and shear to describe the actions of a particular cartoon character
- carry out research into the history of angle measurement and the introduction of trigonometry.

Statistics and probability

Students could:

- collect information relating to used cars for sale (mileage, age, make, engine size, cost now, cost when new) and explore the relationships between different pairs of variables
- select several countries and look for key statistics (population growth, average income and life expectancy) on the Internet in order to answer questions such as, "Do people in richer countries appear to live longer?", "Is there any relation between the size of a population and its average income?"

Discrete mathematics	Discrete mathematics	Discrete mathematics
Students could: • draw two large intersecting circles on the floor and identify two categories of student, for example, {girls} and {students wearing something blue}, and move into one of the four defined regions according to their characteristics • play mathematical games (for example, "bingo", by calculating the answers to simple problems read out by the teacher) to review and reinforce previous learning.	Students could: • create a minimum network for broadband cables to connect five major cities in their country • create a Koch snowflake by starting with a large equilateral triangle, dividing each side into three equal parts, removing the middle part and replacing it with two sides of a triangle equal in length to the part that was removed, and so on.	Students could: • solve a logical puzzle, such as the following: "You have three boxes of fruit, one with apples, one with oranges and one mixed; each box is labelled but the labels are not on the correct boxes of fruit—how can you know what each box contains simply by taking one piece of fruit from one box?" • create their own logic puzzle by using websites such as http://www.edhelper.com/logic_puzzles.htm) • play the chaos game (refer to http://home.inreach.com/kfarrell/fractals.html).

B Investigating patterns

Investigating patterns allows students to experience the excitement and satisfaction of mathematical discovery. Mathematical inquiry encourages students to become risk-takers, inquirers and critical thinkers. The ability to inquire is invaluable in the MYP and contributes to lifelong learning.

Through the use of mathematical investigations, students are given the opportunity to apply mathematical knowledge and problem-solving techniques to investigate a problem, generate and/or analyse information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

Year 1	Year 3	Year 5
Objectives		
At the end of the first year, when investigating problems, in both theoretical and real-life contexts, students should be able to:	At the end of the third year, when investigating problems, in both theoretical and real-life contexts, students should be able to:	At the end of the course, when investigating problems, in both theoretical and real-life contexts, students should be able to:
• apply basic inquiry and mathematical problem-solving techniques, with guidance from the teacher, by identifying variables, posing relevant questions, organizing data and using an appropriate model	• select and apply basic inquiry and mathematical problem-solving techniques to problems by asking searching questions	• select and apply appropriate inquiry and mathematical problem-solving techniques
• recognize simple patterns similar to previously seen examples	• recognize simple patterns in different situations	• recognize patterns
• describe simple patterns in words and/or diagrams	• describe simple patterns as relationships or general rules	• describe patterns as relationships or general rules
• arrive at a result or set of results and make predictions based on extending the pattern(s)	• arrive at a single result or set of results and make predictions consistent with findings	• draw conclusions consistent with findings
• describe simple mathematical relationships.	• explain simple mathematical relationships and general rules using logical arguments.	• justify or prove mathematical relationships and general rules.
Examples of possible learning experiences		
Number Students could: • predict the next three numbers in a sequence • find large numbers that can be reduced to prime factors by their classmates • investigate how many different designs can be made by shading squares in a 3 x 3 square. **Algebra** Students could: • investigate the graphs of $y = mx + c$ using appropriate software • measure and plot the extended length of a spring against the weight of an object hung on the end	**Number** Students could: • determine ways of finding the sum of the terms in an arithmetic sequence, describing their methods in general terms • investigate the meaning of negative exponents using a calculator • investigate the patterns present in the Fibonacci sequence. **Algebra** Students could: • investigate the graphs of $y = (x - a)(x - b)$ and their solutions for different values of y using a graphic display calculator.	**Number** Students could: • be given the diameter of a model of the earth (a globe) as 100 cm, and investigate the diameters of corresponding models of the planets, given their true diameters expressed in standard form ($a \times 10^n$), and discuss the status of Pluto as a planet. **Algebra** Students could: • analyse and compare male and female record times in a particular sport (running, swimming) from 1900 to the present day, and predict times for the year 2050 by investigating lines or curves of best fit for the data collected.

• investigate problems such as the following: "How long does it take to make *n* pieces of toast on a one-sided grill that can take two pieces at a time?" **Geometry and trigonometry** Students could: • investigate the sum of the interior angles of different *n*-sided polygons ($n > 2$) • use different instruments to measure a range of objects and discuss the ease and accuracy of each technique. **Statistics and probability** Students could: • investigate the probabilities for the different outcomes when tossing two coins or rolling two dice. **Discrete mathematics** Students could: • use Venn diagrams to analyse different aspects of after-school activities.	**Geometry and trigonometry** Students could: • write a logical explanation for the sum of the exterior angles of a polygon equalling 360° • investigate how to measure tall structures, telegraph poles, buildings • use geometry to predict the angle of the noontime sun at the two solstices. **Statistics and probability** Students could: • choose, with logical explanations, which measure of central tendency would be most appropriate for typical family size, height of students, amount of pocket money. **Discrete mathematics** Students could: • investigate shortest paths in local networks (bus routes, metro lines) • investigate the concept of map colouring by conducting research into the four-colour problem and attempting to illustrate this rule by colouring a map of their country showing the different regions/states.	**Geometry and trigonometry** Students could: • carry out a survey of the school grounds for the purpose of creating a detailed and accurately scaled map/plan • investigate how a sphere can be projected onto a plane. **Statistics and probability** Students could: • design a questionnaire to elicit data reflecting attitudes to issues relevant to them; circulate this questionnaire to students in their own school and one other school, possibly in another country; then collect and compare the data • create a fund-raising game of chance that is profitable and will attract players. **Discrete mathematics** Students could: • investigate whether, when you start with an odd number *a*, square it to give *b*, subtract 1 to give *c*, divide by 2 to give *d*, and add 1 to give *e*, the equation $a^2 + d^2 = e^2$ will always be satisfied.

C Communication in mathematics

Mathematics provides a powerful and universal language. Students are expected to use mathematical language appropriately when communicating mathematical ideas, reasoning and findings—both orally and in writing.

Year 1	Year 3	Year 5
Objectives		
At the end of the first year, students should be able to communicate mathematical ideas, reasoning and findings by being able to:	At the end of the third year, students should be able to communicate mathematical ideas, reasoning and findings by being able to:	At the end of the course, students should be able to communicate mathematical ideas, reasoning and findings by being able to:
• use appropriate mathematical language (notation, symbols, terminology) in both oral and written communications, with guidance from the teacher	• use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations in familiar situations	• use appropriate mathematical language (notation, symbols, terminology) in both oral and written explanations
• use different forms of mathematical representation (simple formulae, diagrams, tables, charts, graphs and models), with guidance from the teacher	• use different forms of mathematical representation (simple formulae, diagrams, tables, charts, graphs and models)	• use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
• state, in writing and/or verbally, the steps followed in solving simple problems.	• communicate a mathematical line of reasoning in solving simple problems using different forms of representation.	• communicate a complete and coherent mathematical line of reasoning using different forms of representation when investigating complex problems.
Examples of possible learning experiences		
Number Students could: • modify quantities and measurements in well-known events or stories to create absurdities and then act out or model the event or story, for example, speed limits being set at 50 m per hour (instead of 50 km per hour); playing on a football pitch where it is assumed that 1 m^2 = 100 cm^2 • investigate discounts in advertisements in order to determine the best deals. **Algebra** Students could: • explain the steps involved in solving a linear equation • explain the significance of m and c when the line represented by $y = mx + c$ is graphed.	**Number** Students could: • collect media clippings of the inappropriate use of mathematical symbols and terminology, and/or inappropriate representations of data (for example, misleading labelling on graphs) and describe how these could lead to incorrect interpretations. **Algebra** Students could: • use motion recording equipment to create distance/time graphs • create feasible distance/time graphs and physically model the graphs created by others by moving around the classroom.	**General** Students could: • take it in turns to summarize the important elements of selected lessons by putting the information into a class file or posting it on a website in the form of a blog; the document could then be used as a revision tool by the class. **Number** Students could: • be given a series of real-life calculations to carry out using a calculator (for example, "A third of the people in a city with a population of 500,000 live in poverty—how many people live in poverty?") and be asked to justify the number of significant figures given in their answers.

Geometry and trigonometry Students could: • make a scale drawing of a bicycle • investigate the properties of similar two-dimensional shapes (triangles, squares and circles). **Statistics and probability** Students could: • measure the lengths of their ears and represent the data in tables and graphs, and find measures of central tendency • investigate the probability of various events taking place based on available data (for example, the probability of rain on a particular day of the year). **Discrete mathematics** Students could: • use Venn diagrams to classify quadrilaterals that have equal sides, parallel lines, equal angles • draw diagrams showing three different routes they could take to travel from home to a specific destination and determine the best one by considering either times or distances.	**Geometry and trigonometry** Students could: • write out directions, using bearings and distances, to describe the cycle routes in their local area • carry out a survey of their school grounds/campus in order to create an accurate plan. **Statistics and probability** Students could: • collect data from a weather station and represent it graphically as a tool for investigating trends • discuss the advantages and disadvantages of obtaining data by sampling large populations, by referring to sampling techniques used by the media (for example, opinion polls). **Discrete mathematics** Students could: • investigate the similarities and differences between the skills needed for two different occupations using Venn diagrams (for example, music teacher and rock star) • create flow charts to describe some simple mathematical processes (for example, finding the greatest common divisor of two numbers).	**Algebra** Students could: • be given an open-ended problem with fixed and variable costs, such as budgeting for an event, where the solution depends on the parameters, expected outcomes and accuracy of estimates • investigate Newton's laws of motion in the form of algebraic equations, tables and graphs using generated data and data that has been collected experimentally • investigate and describe the trajectory of small objects falling from different forms of transport (bicycles, lorries/trains, hot-air balloons). **Geometry and trigonometry** Students could: • design an orienteering course on the sports field where the beginning and end points coincide, and use practical trials and/or the sine and cosine rules to demonstrate that these points are coincident. **Statistics and probability** Students could: • investigate different methods of sampling large populations (random sampling, stratified sampling, systematic sampling, cluster sampling, convenience sampling) and create a poster explaining each one. **Discrete mathematics** Students could: • conduct a poll among themselves to determine their preferences for different types of music; collate the results in the form of a Venn diagram; then describe the information displayed.
Students are encouraged to choose and use information and communication technology (ICT) tools as appropriate and, where available, to enhance communication of their mathematical ideas. ICT tools can include calculators (simple, scientific and/or graphic display), screenshots, graphing, spreadsheets, databases, and drawing and word-processing software.		

D Reflection in mathematics

MYP mathematics encourages students to reflect upon their findings and problem-solving processes. Students are encouraged to share their thinking with teachers and peers and to examine different problem-solving strategies. Critical reflection in mathematics helps students gain insight into their strengths and weaknesses as learners and to appreciate the value of errors as powerful motivators to enhance learning and understanding.

Year 1	Year 3	Year 5
Objectives		
At the end of the first year, students should be able to:	At the end of the third year, students should be able to:	At the end of the course, students should be able to:
• consider the reasonableness of their results in the context of the problem	• consider the reasonableness of their results in the context of the problem and attempt to explain whether they make sense	• explain whether their results make sense in the context of the problem
• consider the importance of their findings, with guidance from the teacher	• consider the importance of their findings	• explain the importance of their findings
• distinguish between measurement and counting, and demonstrate an appreciation of the difference between degrees of error in measuring and mistakes in counting, measuring and calculating	• consider the degree of accuracy of their results where appropriate and estimate errors in simple measurements	• justify the degree of accuracy of the results where appropriate
• consider alternatives to the method when appropriate, with guidance from the teacher.	• consider alternatives to the method when appropriate.	• suggest improvements to the method when necessary.
Examples of possible learning experiences		
Number Students could: • estimate answers before carrying out calculations • discuss the precision of different measuring instruments (rulers, callipers, protractors, theodolites). **Algebra** Students could: • substitute answers in original problems to check results. **Geometry and trigonometry** Students could: • find the least and greatest amount of paint necessary to paint their bedrooms.	**Number** Students could: • investigate how well the "golden ratio" applies to famous buildings or paintings. **Algebra** Students could: • determine the domain and/or range of functions involving physical processes, for example, the elastic limit of a rubber band as a linear function within a limited domain. **Geometry and trigonometry** Students could: • design an economical shape for a 500 ml bottle of soda • use Pick's theorem to estimate the area of regions on a map	**Number** Students could: • discuss the appropriateness of degrees of accuracy for different data/information found in the media. **Algebra** Students could: • discuss when substitution, graphing or elimination are the most appropriate strategies for solving different sets of simultaneous equations • investigate whether a table-tennis ball rolled off a desk will follow a parabolic path. **Geometry and trigonometry** Students could: • make a sundial and investigate the position of the shadow at different times of the year compared to the pre-calculated positions.

Statistics and probability Students could: • draw a bar chart showing the hours of television watched each day by classmates • collect examples from the media of data displayed in different ways (bar graphs, pie charts, pictograms) and comment on their effectiveness. **Discrete mathematics** Students could: • invent a problem similar to the "Bridges of Königsberg".	• scale up the measurements of a popular doll or toy model to determine whether their measurements lead to absurdities when their proportions are scaled to a realistic level. **Statistics and probability** Students could: • analyse the data collected to investigate an environmental problem. **Discrete mathematics** Students could: • create and model a traffic problem involving one-way and two-way streets.	**Statistics and probability** Students could: • investigate, by collecting appropriate data, whether the annual harvest of a particular fish species justifies the creation of conservation laws. **Discrete mathematics** Students could: • devise emergency exit paths to support the swift and safe evacuation of students and staff in their school.

MYP Assessment
Rubric Design

MYP Unit Question: Area of Interaction:
Significant concept:
Summative Task: (Briefly describe)

Criterion _____: _____

Achievement Level	Level Descriptor Year 5	Level Descriptor Year 3	Level Descriptor Year 1
0			
1-2			
3-4			
5-6			

How to:

Survey the criteria and limit to those that best measure the task
Within each selected criterion, choose one or two MYP objectives that either aligns with state / provincial standards or national curriculums.
Highlight the objective(s) in the descriptors that are reflected in the chosen criterion.
Modifying the rubrics for age-appropriateness using the interim objectives.
Select the appropriate interim objective (either year 3 or 1) and write a level descriptor for the highest band
Keeping the bolded descriptors within the band, modify the rubrics all the way up to zero while keeping the integrity of the levels intact.

Criterion A Template: Knowledge and Understanding

Which assessment ***task*** is it? _____

Objective?_____

Assessment tasks for this criterion are likely to be class tests, examinations, real-life problems and investigations that may have a variety of solutions.

Achievement level	Year 5 Descriptor	Interim level descriptor
7-8	The student **consistently** makes appropriate deductions when solving **challenging** problems in a **variety** of contexts including **unfamiliar situations**.	
5-6	The student **generally** makes appropriate deductions when solving **challenging** problems in a **variety** of **familiar** contexts.	
3-4	The student **generally** makes appropriate deductions when solving **more complex** problems in **familiar** contexts.	
1-2	The student **generally** makes appropriate deductions when solving **simple** problems in **familiar** contexts.	
0	The student does not reach a standard described by any of the descriptors above	

Notes

- **Unfamiliar situation**: challenging questions or instructions set in a new context in which students are required to apply knowledge and/or skills they have been taught.
- **Deduction**: reasoning from the general to the particular/specific to reach a conclusion from the information given.
- **Context**: the situation and the parameters given to a problem.

Criterion B Template: Investigating Patterns

Which assessment ***task*** is it? _____

Objective?_____

Assessment tasks for this criterion should be mathematical investigations of some complexity, as appropriate to the level of MYP mathematics. Tasks should allow students to choose their own mathematical techniques to investigate problems, and to reason from the specific to the general. Assessment tasks could have a variety of solutions and may be set in real-life contexts. Teachers should clearly state whether the student has to provide a justification or a proof. Teachers should include a good balance between tasks done under test conditions and tasks done at home in order to ensure the development of independent mathematical thinking.

Achievement level	Year 5 Descriptor	Interim level descriptor
7-8	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, draws the **correct conclusions** consistent with the correct findings, and **provides justifications or a proof**.	
5-6	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, and **draws conclusions** consistent with findings.	
3-4	The student **applies** mathematical problem-solving techniques to recognize patterns, **and suggests** relationships or general rules.	
1-2	The student **applies**, **with some guidance**, mathematical problem-solving techniques to recognize simple patterns.	
0	The student does not reach a standard described by any of the descriptors above	

Notes

- **Pattern**: the underlining order, regularity or predictability between the elements of a mathematical system. To identify pattern is to begin to understand how mathematics applies to the world in which we live. The repetitive features of patterns can be identified and described as relationships or generalized rules.
- **Justification**: give valid reasons or evidence to support the conclusion and explain **why** the rule works.
- **Proof**: a mathematical demonstration of the truth of the relationship or general rule.
- A student who describes a general rule consistent with incorrect findings will still be able to achieve in the 5–6 band, provided that the rule is of an equivalent level of complexity.
- Clear guidance should be incorporated in the teachers' task to ensure all students receive the same guidance and understand the basic requirements of the task.

Criterion C Template: Communication

Which assessment ***task*** is it? _____

Objective?_____

Assessment tasks for this criterion are likely to be real-life problems, tests, examinations and investigations. Tests and examinations that are to be assessed against criterion C must be designed to allow students to show complete lines of reasoning using mathematical language.

Achievement level	Year 5 Descriptor	Interim level descriptor
5-6	The student shows **good use** of mathematical language and forms of mathematical representation. The lines of reasoning are **concise, logical and complete**. The student moves **effectively** between different forms of representation.	
3-4	The student shows **sufficient use** of mathematical language and forms of mathematical representation. The lines of reasoning are **clear though not always logical or complete**. The student moves between different forms of representation with **some success**.	
1-2	The student shows **basic use** of mathematical language and/or forms of mathematical representation. The lines of reasoning are **difficult to follow**.	
0	The student does not reach a standard described by any of the descriptors above.	

Notes:

- **Mathematical language**: the use of notation, symbols, terminology and verbal explanations.
- **Forms of mathematical representation**: refers to formulae, diagrams, tables, charts, graphs and models used to represent mathematical information.

Criterion D Template: Reflection in Mathematics

Which assessment ***task*** is it? _____

Objective?_____

Assessment tasks are most likely to be mathematical investigations or real-life problems. Generally these types of tasks will provide students with opportunities to use mathematical concepts and skills to solve problems in real-life contexts.

Achievement level	Year 5 Descriptor	Interim level descriptor
5-6	The student **critically explains** whether his or her results make sense in the context of the problem. The student provides a **detailed explanation** of the importance of his or her findings in connection to real life where appropriate. The student **justifies** the degree of accuracy of his or her results where appropriate. The student suggests improvements to his or her method where appropriate.	
3-4	The student **correctly but briefly explains** whether his or her results make sense in the context of the problem. The student **describes the importance** of his or her findings in connection to real life where appropriate. The student **attempts to justify** the degree of accuracy of his or her results where appropriate.	
1-2	The student **attempts to explain** whether his or her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life where appropriate.	
0	The student does not reach a standard described by any of the descriptors above.	

Notes:

- **Explain**: give a detailed account including reasons or causes.
- **Describe**: give a detailed account.

Criterion D: Reflection- Rubric template

Level	Descriptor (Step 1)	Interim Objective added (Step 2)	Boldface adjusted (Step 3)	Task-specific (Step 4)	Kid-friendly (Step 5)
5-6	The student **critically explains** whether his or her results make sense in the context of the problem and provides a **detailed explanation** of the importance of his or her findings in connection to real life.	The student *considers the reasonableness of their results in the context of the problem* and *attempts to explain whether they make sense.*	The student ***considers*** *the reasonableness of their results in the context of the problem and* ***attempts to explain*** *whether they make sense.*	The student **considers** the reasonableness of *the rocket's specifications*, in the context of the problem and *the student* **attempts to explain** whether *the rocket's specifications* make sense.	The student **considers** the reasonableness of the rocket's specifications in the context of the problem, and **attempts to explain** whether the rocket's specifications make sense. (no change for this one from step 4 to step 5)
3-4					
1-2					
0					

MYP Unit: *Oh why, oh why can't I?*

- communicate a mathematical line of reasoning in solving simple problems using different forms of representation.
- use different forms of mathematical representation (simple formulae, diagrams, tables, charts, graphs and models).

Criterion C: Communication in mathematics

L of A	Level descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1-2	The student's presentation to the boss shows **basic** use of mathematical language **and/or** forms of mathematical representation. The student's graphic, writing and calculations are **difficult to follow**.
3-4	The student's presentation to the boss shows **sufficient** use of mathematical language **and** forms of mathematical representation. The student's graphic, writing and calculations are **clear** but are not **complete** or may not tell the **same story.**
5-6	The student's presentation to the boss shows **good** use of mathematical language **and** forms of mathematical representation. The student's graphic, writing and calculations are **complete** and tells the **same story.**

MYP Unit: *Oh why, oh why can't I?*

- consider the reasonableness of their results in the context of the problem and attempt to explain whether they make sense

What a student receives

Criterion D: Reflection in mathematics

L of A	Level descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1-2	The student **attempts to consider** the reasonableness of the rocket's specifications in the context of the problem, and The student **attempts to describe** whether the rocket's specifications make sense.
3-4	The student **correctly but briefly considers** the reasonableness of the rocket's specifications in the context of the problem, and the student **describes** whether the rocket's specifications make sense.
5-6	The student **considers** the reasonableness of the rocket's specifications in the context of the problem, and **attempts to explain** whether the rocket's specifications make sense.

International Baccalaureate

Personal Project

Topic 5

Page 1

Aims of the Personal Project

Page 2

Aims

Allow students to:

- demonstrate the personal abilities and skills required to produce and present an extended piece of work
- engage in personal inquiry, action and reflection on specific topics and issues
- focus on, and demonstrate an understanding of the Areas of Interaction
- reflect on learning and share knowledge, views and opinions

Page 3

Is a Personal Project appropriate at Year 3?

- The age-appropriate expectations of a student at Year 3 are not the same as Year 5. Therefore, a "mini personal project" is not age-appropriate
- What types of endeavors/recognition might be age-appropriate to celebrate progress at Year 3?

Personal Project Examples

Quilting a Family's History
Human ingenuity

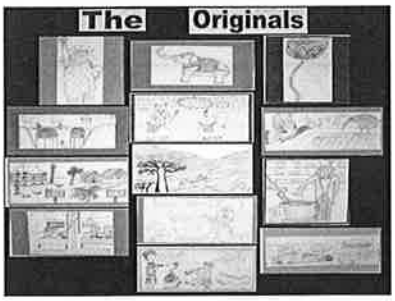
Phnom Penh Pop
Community and service

Page 7

Eco-Home: The Individual Gaia
Environments

Page 8

Raising Cultural Awareness at School
Health and social education



Page 9

Teaching my peers how to play chess
Approaches to learning

Characteristics of Personal Projects

- Students are encouraged to use a combination of skills developed in a variety of subjects and through approaches to learning
- Inspired by and focused on theme/topic/issue closely connected to at least one area of interaction
- Based on a careful choice of type and goal in terms of skills and techniques required

Goal / Theme / Topic

In the context of the personal project:

- Topic: a subject matter
- Goal: the objective of a person's ambition or effort, must be centered in an Area of Interaction
- Means: the way the student is going to achieve his/her goal

What is a realistic goal for the P2?

It's one that:

- Allows the student to investigate and focus on a theme
- Should not require overly complex procedures
- Is not overly ambitious
- Must not require a lengthy process of learning

TEN ASSESSMENT ESSENTIALS

1. Objectives: Describe what students should be able to do
    a. Year 5 are found in subject guide
    b. Years 1-4 use the interim objectives in subject guide
    c. Must be age and developmentally appropriate
2. Assessment Criteria: Describe how we will judge to what degree the student has achieved the objective.
    a. Objective bullets (strands) = assessment criteria descriptors
    b. Year 5 are found in subject guide
    c. Years 1-4 use the interim objectives to develop
3. Assessment Task: This is designed by teachers to allow students to demonstrate that they can meet the objectives.
    a. Must allow students to achieve the highest levels of achievement on the assessment criteria.
    b. As you design tasks, keep the year 5 prescribed minimum tasks in mind.
4. Assessment Rubrics: clearly identifies the teacher's expectations.
    a. Year 5 are found in the subject guide.
    b. Year 1-4 must be developed
        i. Adjust descriptors so they are age and developmentally appropriate.
        ii. You may use kid-friendly language.
        iii. Give task-specific clarifications
    c. Must not add or take away from the criteria.
5. Exemplars: Show students examples of work that would be awarded the various levels of achievement on the rubric.
6. Standardization: for subject-alike teachers
    a. Must develop common summative assessment tasks.
    b. Must agree on how the assessment criteria are applied.
7. Giving grades on an assessment task
    a. Determine the level of achievement for the criteria (usually 1 or 2 criteria at a time)
    b. Convert to a district grade if this is part of your assessment plan. (NOTE you may convert an MYP level of achievement to a district grade, but you may not convert a district grade to an MYP level of achievement.
8. Giving Final Grades (required in year 5)
    a. Make sure to complete the required number of assessments for each criterion.
    b. Determine a final level of achievement for each assessment criterion.
    c. Add final levels together and use the grade bands to determine a final grade 1-7.
9. Reporting MYP grades/levels of achievement.
    a. Determine when and how often grades will be reported to parents and students.
    b. Convert to a district grade (if this is part of your assessment plan)
    c. Reporting should occur on a regular basis in a meaningful way.
10. Monitoring/Moderation
    a. Decide which process your school will use.
    b. Monitoring: must be done within two years of the evaluation visit
        i. Monitoring for evaluation
        ii. Monitoring before moderation
    c. Moderation: Validates MYP grades
        i. Record of Achievement (transcript)
        ii. MYP certificate (if student meets all the requirements)

Standard Mathematics Broad based classroom Test

1. Write in scientific notation: 32500 = 3.2×10^4 0.000326 = 3.26×10^{-4}

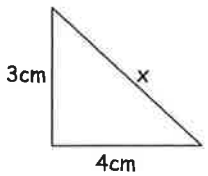
2. Write in as a number : 2.6×10^3 = 2600 1.9×10^{-2} = 0.019

3. Find the length of the hypotenuse of the triangle

$x^2 = 3^2 + 4^2$

$x^2 = 9 + 16$ $\quad x = \sqrt{25}$

$x^2 = 25$ $\quad x = 5$



4. Multiply out the brackets and simplify: a) 2(4f+3) + 3(2-5f)

$= 8f + 6 + 6 - 15f$

$= 8f + 12 - 15f$

$= -7f + 12$

Answer: $-7f + 12$

5. A bag contains 10 balls numbered 1 to 10, one is taken out.

List the balls whose numbers are:

a) a factor of 15 1, 3 and 5

b) a prime number 1, 2, 3, 5 and 7

c) a multiple of 3 3, 6 and 9

d) a square number 1, 4 and 9

What is the probability that the number on the ball is a:

a) a factor of 15 3/10

b) a prime number 5/10

c) a multiple of 3 3/10

d) a square number 3/10

6. a) Write 80 as a product of prime factors
   b) Is 80 a square number? Explain.
   c) Write $\sqrt{80}$ in the form $a\sqrt{b}$

80 | 2	$80 = 5 \times 2 \times 2 \times 2 \times 2$
40 | 2	$80 = 5 \times 2^4$
20 | 2	
10 | 2	
5 | 5	
1	

$\sqrt{80} = 16\sqrt{25}$

Answer: a) $80 = 5 \times 2^4$ b) No because there is not any whole number that multiplies by itself to make 80 c) $16\sqrt{25}$

7. Simplify the following expressions giving your answers with positive indices:

a) $a^3 \times a^2 =$ $a \times a \times a \times a \times a = a^5$

b) $\frac{a^3}{a^2} =$ $a \times a \times a \div a \times a = a^{1.5}$

c) $(-p)^3 =$ $-p \times -p \times -p = -p$

d) $(x^4)^2 =$ x^8

8. Find the value of x for each of the equations:

a) $-2x + (-40) = 42$

$-2x + (-40) = 42$
$= -2x - 40 = 42$
$+40 \quad +40$
$= -2x = 82$
$\div -2 \quad \div -2$
$= x = -41$

Answer: a) x= -41

b) $\frac{x}{2} + 5 = -7$

$\frac{x}{2} + \frac{5}{-5} = \frac{-7}{-5}$

$\frac{x}{2} = -12$
$\times 2 \quad \times 2$
$x = -24$

b) x= -24

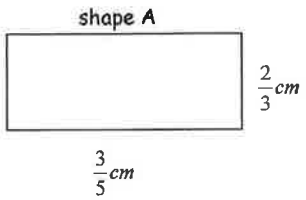
9. Of 180 pupils, $\frac{4}{5}$ went to Rock in Rio. a) How many pupils is this? b) What percentage is this?

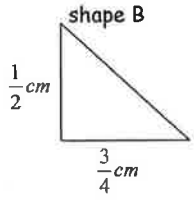
$180 \div 5 = 36$ or $\frac{4}{5} = 0.8$
$36 \times 4 = 144$ $0.8 \times 180 = 144$

$180 \div 100 = 1.8$
$1.8 \times p = 144$
$\div 1.8 \quad \div 1.8$
$p = 80$

Answer: a) 144 pupils b) 80%

10. Find, leaving your answer as a simplified fraction:
a) the perimeter of shape A b) the area of shape B





$\frac{2}{3} + \frac{2}{3} + \frac{3}{5} + \frac{3}{5}$

$= \frac{10}{15} + \frac{10}{15} + \frac{9}{15} + \frac{9}{15}$

$= \frac{38}{15} = 2\frac{8}{15}$

Answer: a) $2\frac{8}{15}$

$\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$ $\frac{3}{8} \div \frac{2}{1}$

$= \frac{8}{3} \times \frac{2}{1}$

$= \frac{16}{3} = 5\frac{1}{3}$

b) $5\frac{1}{3}$

11. In 2005, 20 285 797 passengers passed through a Portuguese airport, of these 55% passed through Lisbon airport. On average, each passenger carried 16.8Kg of luggage. Calculate the total weight carried by the passengers, passing through Lisbon.

20,285,797 ÷ 100 = 202857.97

202857.97 x 55 = 11,157,188.35

16.8 x 11,157,188.35 = 187,440,764.3Kg of luggage

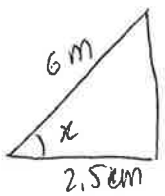
Answer: 187,440,764.3kg

12. Simplify the following numerical expression leaving you answer in the form $a\sqrt{b}$.

$\sqrt{2} \times \sqrt{3} \times \sqrt{2} = \sqrt{12} = \ldots$

Example 2

13. A ladder 6m long is leaning against a wall. The foot of the ladder is 2.5m from the base of the wall. Draw a diagram and find what angle does the base make with the ~~wall~~ ground



$\cos x^\circ = \frac{2.5}{6}$

$\cos x^\circ = 0.42$

$\cos^{-1}(0.42) = 65.2^\circ$

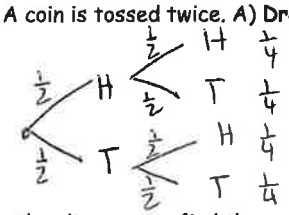
Answer: 65.2°

14. Factorize the following:

a) $5y^2 + 10y =$ $y(5y + 10)$

b) $m^4 - m^5 =$ $m(m^3 - m^4)$

15. A coin is tossed twice. A) Draw a tree diagram to represent this information.



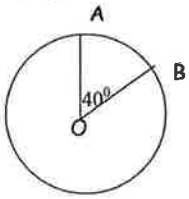
Use the diagram to find the probability that:

a) at least one of the coins is Heads $\frac{3}{4}$

b) both coins are Tails. $\frac{1}{4}$

c) one Head only $\frac{2}{4}$

16. Consider the diagram below where angle AOB measures 40° and the radius 5cm, and find:



a) the area of the sector AOB

b) the length of the smaller arc AB

$360 \div 40 = 9$
$d = 5 \times 2 = 10$
$\pi \times d = C$
$\pi \times 10 = 31.42$
$L_A = 31.42 \div 9 = 3.49$
$A = \pi \times r^2$
$A = \pi \times 5^2$
$A = \pi \times 25$
$A = 78.54$

$A_S = 78.54 \div 9 = 8.73$

Answer: a) $8.73 cm^2$ b) 3.49

17. Solve the following simultaneous equations by any method you find appropriate:

$$\begin{cases} 2x + y = 5 \\ x + y = 7 \end{cases}$$

$2x + y = 5$
$\ominus\ x + y = 7$
$x = -2$

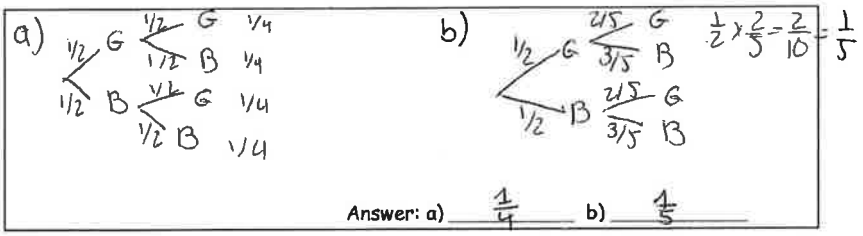
$2 \times (-2) + y = 5$
$-4 + y = 5$
$+4 \quad +4$

$y = 9$
check
$-2 + 9 = 7$

x = −2 y = 9

Example 2

18. There are 2 blue marbles and 3 green marbles in a bag. Pedro picks one marble, and then picks another one. What is the probability that he picked 2 green marbles if:
   a) he did replace the first marble picked?
   b) he did not replace the first marble picked?



Answer: a) $\frac{1}{4}$ b) $\frac{1}{5}$

19. Solve the following quadratic equations by factorizing: $x^2 - 5x + 6 = 0$

$x^2-5x+6=0$ check: $x=2 \Rightarrow 2^2-5\times2+6=0$ ✓
$(2,3)$ $x=3 \Rightarrow 3^2-5\times3+6=0$ ✓
$x=2$ or $x=3$

x = 2 or x = 3

20. Consider the following mobile phone companies:
Vodafix which charges a fixed amount of 5€ a month and 0.15€ per minute of conversation, and Optimex which charges no fixed amount but the calls cost 0.25€ per minute.

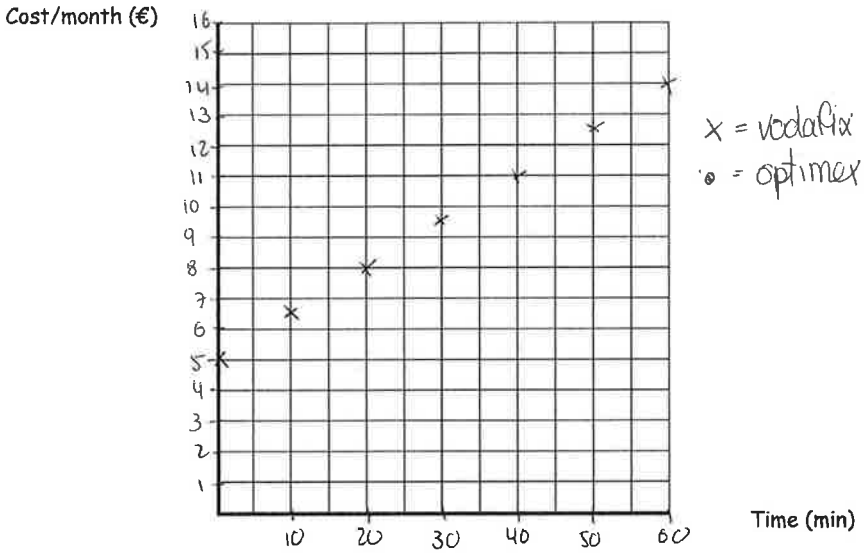
a) Write an equation for the cost over time for each company. Use C for the cost in euros and T for the time in minutes.

$C_{Vodafix}$= 0.15+5 per 1 min $C_{Optimex}$ = 0.25 = C per 1 min

b) Find the cost of 60min of conversation with each of the 2 companies.

$C_{Vodafix}$= 5 + (0.15*60) = 14 $C_{Optimex}$ = 0.25x60 = 15

c) Graph and label each equation for the first 60min. using the pair of axis below.



c) When would each company be a better choice?

Monitoring of Assessment

Monitoring of assessment-generalities

Advisory service to help authorized schools apply MYP assessment principles, not linked to validation of students' grades

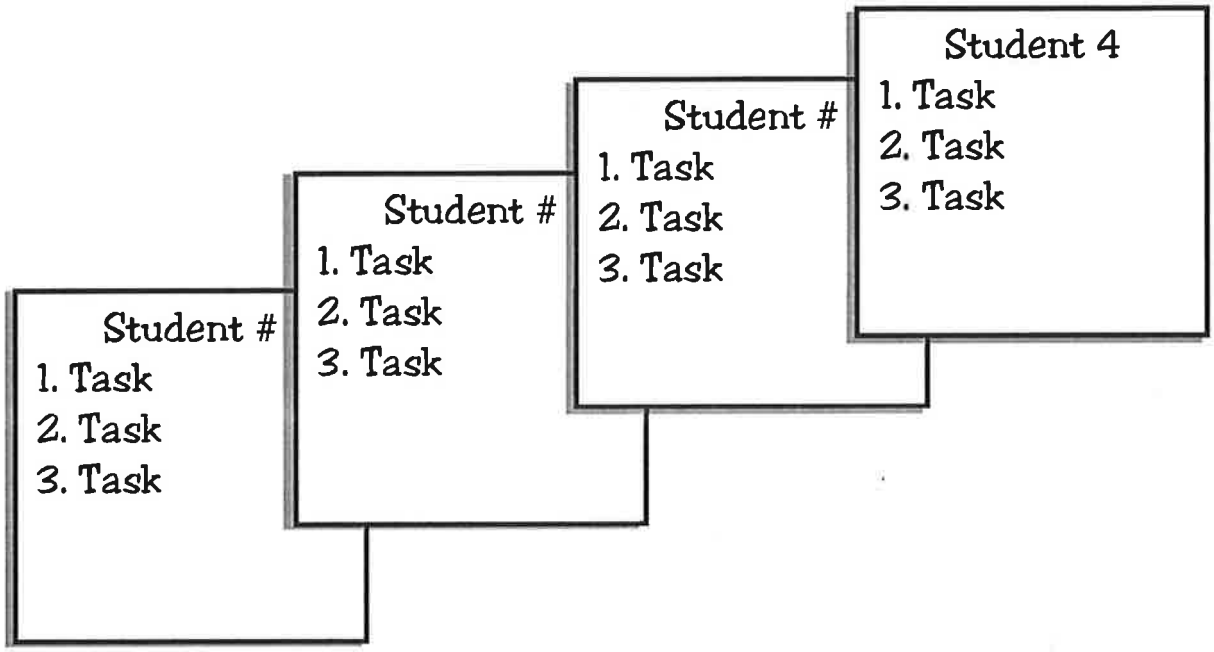
Between September and April

Experienced MYP assessors and subject specialists

At IBCA

Preliminary step in preparing for moderation, required part of programmed evaluation for schools not submitting for moderation, general guidance/feedback

Monitoring of assessment-composition of a sample



4 folders students work or 4 personal projects = 1 sample

5th Folder
Information
about the task

Monitoring of assessment-content of a folder

- Each folder should contain:
  - Tasks matching requirements of moderation (Advised)
  - Forms F4.2/F4.3 or F4.4
- A 5th folder should contain:
  - Information about organization of course (time allocation, possible integration, with other subjects. . .)
  - Test papers, mark schemes, instructions given to students, information on the application of criteria to the work
  - School specific criteria (if relevant)
- Each folder must be submitted in English, French, Spanish or Chinese

Monitoring of assessment-feedback

- Are the tasks appropriate?
- Are criteria addressed completely?
- Do tasks allow students to reach highest levels of achievement?
- Are the level of complexity of tasks related to the objectives and framework?
- Are supporting materials appropriate and clear?
- Is teacher's assessment consistent?
- Areas of strong/weak performance?
- Do schools summative respect the objectives?

HERITAGE REGIONAL HIGH SCHOOL
IBMYP REPORT CARD 2008-2009

Note to student and parents:

This document provides an assessment of the criteria in each subject as well as a self-reflection of the IB learner profile. This report should be used by the student to determine which areas require attention in future years of the program.
A full description of these criteria is available to the student and parents in the student IB binder. As well the binder provides further information on the IB learner profile.
Students are expected to understand the academic and attitudinal objectives of the program and conscientiously strive to develop these qualities within the contexts of all their courses, their community & service projects and personal project.
Please understand that should serious problems persist in any of these areas, transfer to the Regular Studies Program will be required.

IB CRITERIA ASSESSMENT

	CRITERIA							
SUBJECT	**A**	**B**	**C**	**D**	**E**	**F**	**TOTAL**	**RATING ON 7**
Arts	/8	/10	/8	/8			/34	
Humanities	/10	/10	/10	/8			/38	
Language A	/10	/10	/10				/30	
Language B	/8	/8	/8	/8	/16		/48	
Mathematics	/8	/8	/6	/6			/28	
Physical Education	/8	/6	/10	/8			/32	
Science	/6	/6	/6	/6	/6	/6	/36	
Technology	/6	/6	/6	/6	/6	/6	/36	

Student signature:_____ **Parent signature:**_____ **Date:**_____

Student reflections on the AOI: In the space below, give a brief explanation of your most meaningful experience working with each AOI this year.
ATL:
Human Ingenuity:
Environments:
Health & Social:
Community & Service:

IB LEARNER PROFILE

For each of the attributes of the IB learner profile, identify the attribute as 1-Strong 2-Good or 3-In need of work

SUBJECT	RATING	JUSTIFICATION (use examples to support your self-rating)
Inquirer		
Knowledgeable		
Critical Thinker		
Communicator		
Principled		
Open-Minded		
Caring		
Risk-taker		
Balanced		
Reflective		

International Baccalaureate
Baccalauréat International
Bachillerato Internacional

Middle Years Programme

Personal project: Changes to objectives and criteria

Purpose of this document

This document is intended to provide a brief overview of the new *Personal project guide* and the changes that have occurred. The guide will be published in January 2011. It is for use from September 2011 or January 2012, depending on the start of the school year, and for first use in final assessment in June 2012 (northern hemisphere) and December 2012 (southern hemisphere). Schools are advised to wait for publication of the new guide in 2011 before making amendments to any documents about the personal project they give to parents or students.

The personal project remains a project based on a topic of personal interest to the student with a focus area of interaction and is completed over a period of time.

The revised aims reflect the current aims, with the addition of the student developing confidence as a lifelong learner as a result of completing the personal project. Changes to the objectives and assessment criteria are explained in the following table. The weighting of each criterion remains the same with a maximum level of 4. The level descriptors have a single achievement level.

Significant changes to the personal project are as follows.

The project report has been formerly known as the "written statement", "structured writing" or "personal statement". The project report can be produced in different formats, including a written, oral or multimedia report. Whichever format the project is reported through, the same assessment criteria apply. Although the International Baccalaureate (IB) would encourage schools to consider any of the formats, ultimately schools should use their discretion in deciding on which formats to make available to students. Logistics and resources will need to be considered during the organization of the project stage in the school. The project report has a specific structure that is explained in the guide. This includes: title page; table of contents; body of the report; bibliography; appendices. The body of the report is structured around the objectives and criteria: the goal, selection of sources, application of information, achieving the goal and reflection on learning.

If a student chooses to write an essay as the product of their project, the essay is separate to the project report.

It is strongly recommended that students choose one area of interaction only as a focus to the project.

Overview

2004 objective/ criterion	2011 objective/ criterion	What has changed and why?
G Personal engagement	A Use the process journal	• In the 2004 guide, the application of approaches to learning (ATL) skills and the working behaviours associated with these are the focus of objective/criterion G "Personal engagement", which is used as an holistic judgment of the students engagement with the project. The process journal is referred to as part of this preamble. The descriptors of this objective/criterion refer to "required qualities" and "working behaviours". In the 2011 guide, while not being called personal engagement, objective/criterion A is still a measure of the student's engagement with the project through his or her use of the process journal. It is essentially about the student recording the process using ATL skills and showing evidence of his or her engagement. • A significant difference is that this new objective/criterion will be moderated when samples of student work are submitted for moderation. It will be necessary for extracts from the process journal to be included with the project report in order to support the level awarded for objective/criterion A. The complete process journal will not be sent and a limited number of extracts will be submitted. The new guide will provide more specific guidelines about the number and type of extracts. It is expected that the student would be involved in the selection of extracts along with the supervisor. • The reasons for these changes are to promote the use of the process journal more strongly and to acknowledge students' good practice during the project. Apart from its important role in enabling the student to report the project following completion of the outcome/product, the process journal authenticates the work of the student. The format is discussed in the guide. However, there is flexibility for students. The moderation of the use of the process journal is to ensure that this aspect of the personal project is considered as important as completing an outcome or product.
A Planning and development	B Define the goal	• An item that has been removed from this objective/criterion is the requirement for students to describe the steps that will be followed to achieve the goal. There were several places in the personal project report based on the 2004 guide where students discussed the planning, the process and the reflection on the process and there was overlap between these aspects. It is not necessary for students to discuss how they intend to complete the project in this section, as the whole project report is a summary of this process and will reflect the steps that they took. Specific planning for the project will feature in the process journal in the form of notes, annotated illustrations or Mind Maps® for example, and provide evidence through that source. • An addition that has been made is for the student to create specifications that they will use to evaluate the outcome or product. The specifications are essentially a checklist of features or aspects that the outcome or product must

2004 objective/ criterion	2011 objective/ criterion	What has changed and why?
		meet. As the student decides on his or her goal and the outcome/product of the project, her or she will define exactly what he or she wants to achieve. The specifications enable the student to focus clearly on his or her outcome/product. These specifications are detailed in the project report in order to meet one of the strands of this objective/criterion. There is an overlap here with the specifications that are used in the design cycle in the MYP *Technology guide* and the artistic intentions as referred to in the appendix of the MYP *Arts guide*, "The intended or planned outcomes or goals for the artwork". It is anticipated that specifications may change as the student works on the project and discovers new information or challenges. However, the specifications that are reported should be the final ones that were developed during the process. The reason for expecting the creation of specifications is to ensure that students are focusing on goals that are realistic as well as challenging. Students are expected to think ahead about the outcome or product of the project and define it as clearly as possible at the early stages of the process. This is not new to the MYP and throughout the MYP, students will have been receiving guidelines, criteria or instructions that tell them what is required for a specific task. They will have had opportunities to practise creating their own criteria or specifications in different contexts in subject groups.
B Collection of information/ resources	C Select sources	• The 2004 and 2011 objectives and criteria both require students to select sources of information. The differences are the following. – The use or application of information has been placed in the objective/criterion D "Apply information". – Students are expected to evaluate the sources, which involves the use of information literacy skills. – Bibliography and referencing conventions are placed in the objective/criterion G "Report the project", which relates to reporting the project and organizing the report coherently. • Separating the selection of sources from the use of sources is to help the student focus on the process of selecting information and his or her ability to think critically about information, which is the evaluation of sources, as referred to in the previous bullet point. The use of these sources and the information is addressed in objective/criterion D "Apply information". The referencing of sources is part of the reporting of the project and has been placed in this objective/criterion as it relates to the presentation of information.
C Choice and application of	(See objective/criteri	• This objective/criterion has been removed and been incorporated into the objective/criterion D "Apply information". There is overlap between application of information and/or techniques depending on the nature of the project. When

2004 objective/ criterion	2011 objective/ criterion	What has changed and why?
techniques	on D.)	students select sources, these may relate to techniques as well as information.
D Analysis of information	D Apply information	• There was confusion over the use of "reflection" in the descriptors of this objective/criterion in the 2004 guide. The objective/criterion in the 2011 guide refers specifically to how the student transfers and applies information or techniques in order to achieve the goal. Students need to make this explicit in the report by explaining how they used the information from sources in order to move their project forward. In *MYP: From principles to practice* (August 2008), the ATL skill area "Transfer" is partly defined as "making connections—including using knowledge, understanding and skills across subjects to create products or solutions, applying skills and knowledge in unfamiliar situations"..
N/A	E Achieve the goal	• This is a new objective/criterion and includes the final outcome/product as part of the assessment. This has been included in response to feedback from schools that students felt the outcome or product was not being taken into consideration in the assessment. This objective/criterion will not be moderated. • The student will use the specifications created earlier in the process to evaluate the outcome or product and to self-assess with the assistance of the supervisor. It is expected that the student reports his or her evaluation in the project report but the evaluation itself is not assessed.
E Organization of the written work	(See objective/criterion G.)	• This objective/criterion is still a part of the personal project and is called "Report the project" and has become the final objective/criterion. • The same aspects are included: structure and clarity of language. Referencing has additionally been placed in this objective/criterion rather than in the old objective/criterion B "Collection of information/resources" as it relates to the presentation of the report.
F Analysis of process and outcome	F Reflect on learning	• This objective/criterion has been changed to a holistic reflection on learning about the topic and area of interaction, as well as ATL. Students are not expected to reflect in detail on each stage of their project. Rather, this is an opportunity for them to highlight their specific learning in the topic through completing the project as well as how their understanding of the area of interaction has developed. • The report as a whole is a summary of the process of completing the project and all of the assessment criteria B-F in the 2011 guide relate to the analysis of the process. The process journal is the tool for recording this process. • Students are expected to reflect on themselves as learners, thinking about how they have developed their ATL skills through completing the project. In many project reports based on the current 2004 guide, students comment on their development in ATL and this is a way of formalizing this further and encouraging it.

2004 objective/ criterion	2011 objective/ criterion	What has changed and why?
		It also emphasizes that approaches to learning is a part of every project. ATL is only a **focus** area of interaction in some clear cases. • The evaluation of the outcome/product has been placed in the objective/criterion E "Achieve the goal", as this objective/criterion specifically addresses the outcome/product.
	G The project report	• This objective/criterion relates to how the student communicates the project through the report. It focuses specifically on the report as a tool for communicating the process and outcome/product of the project. It takes into consideration the structure and length of the report, as well as language and referencing conventions used. This does not differ substantially from the 2004 objective/criterion E: "Organization of the written work". • As mentioned earlier, the difference is that the report can take various formats. The reason for making this change is to open up the possibilities for students and address different learning and communication preferences. The *Personal project guide* stresses the importance of considering student strengths when deciding on a format for the project report and not underestimating the preparation required for an oral or multimedia report and their challenges. The ultimate decision for the project report format is with the school although the IB would encourage schools to be open-minded with the options given to students based on resourcing capabilities.

LAMAR H. S. MENTORING GUIDELINES

The following guidelines have been developed to help faculty and staff better understand the role of the mentor. IBO places a great value in that students should be able to have an available adult mentor to help guide them with their personal project. In many cases, students are willing to put forth more effort when they are encouraged by a teacher they know. On the other hand, they can be quick to be discouraged when turned down. Take a look at the following guidelines and please take them into consideration when mentoring our students.

The students should have a mentoring form. They can get it from their Language A teacher.

What are your responsibilities?

Meet with the student once a month-Sept, Oct, Nov, Dec, Jan, Feb, and one time in March. At lease 10-15 minutes

When?

Primarily, in IDC meetings or before school, at lunch, or briefly after school.

What do I do?

- Listen and encourage the student. Give suggestions on how to make the project meaningful. Ask questions. Get to know the student.
- Has the students selected a good topic? Will the topic challenge them?
- What AOI has the student decided on as research focus? ATL skills?
- Has the student used the design cycle to launch inquiry and guide them through the process?
- Check to see if they are journaling the process. Ask to see the process journal/log book. Have you begun to write about your experience?
- Send them in the direction of others who might be knowledgeable in the field of their topic.
- Check their progress. e.g. "Where are you", "What's next", Have you thought about....?", "Are you on target for completion", "I like what you're doing."
- Carry out a formative assessment. Give them immediate feed back.
- Check to see if they have research documentation. MLS format.
- Identify strengths and weaknesses of the project - make sure the students document them.
- Stress meeting the deadlines

MYP Vertical and Horizontal Planning Document
Areas of Interaction - Environments

SCIENCE

	Unit Topic	Unit Title	Unit Question	Significant Concept / Learning Expectations ⇩
Year 1				
Year 2	*Heat*	*It's getting HOT in here…*	*What's all the "heat" about?*	*Challenge the status quo.*
Year 3				
Year 4				
Year 5				

ART

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE A

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE B

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

TECHNOLOGY

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

HUMANITIES

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

MATH

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

PHYSICAL EDUCATION

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

Vertical and Horizontal Planning Document
Areas of Interaction - Community and Service

SCIENCE

	Unit Topic	Unit Title	Unit Question	Significant Concept / Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

ART

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE A

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE B

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

Vertical and Horizontal Planning Document

Areas of Interaction - Human Ingenuity

SCIENCE

	Unit Topic	Unit Title	Unit Question	Significant Concept / Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

ART

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE A

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE B

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

TECHNOLOGY

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

HUMANITIES

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

MATH

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

PHYSICAL EDUCATION

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

Vertical and Horizontal Planning Document

Areas of Interaction - Health and Social Education

SCIENCE

	Unit Topic	Unit Title	Unit Question	Significant Concept / Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

ART

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE A

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

LANGUAGE B

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ↓
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

TECHNOLOGY

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

HUMANITIES

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

MATH

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

PHYSICAL EDUCATION

	Unit Topic	Unit Title	Unit Question	Significant Concept/ Learning Expectations ⇩
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

Areas of Interaction

Vertical and Horizontal Planner

HEALTH AND SOCIAL EDUCATION

Health and social education delves into the range of human issues that exist in human societies, such as social structures, relationships and health. The area can be used by students to find out how these issues affect societies, communities and individuals, including students themselves. Through the area of health and social education, students can identify and develop skills that will enable them to function as effective members of societies, as well as learning about how they are changing and how to make informed decisions that may relate to their welfare.

Student Learning Expectation: Developing an understanding of ourselves in the wider society—including issues such as freedom, government health policies and globalization

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*People fight social injustice when it becomes personal.*	*Lessons are learned through conflict.*	*We are more alike than we are different.*	*There is predictability to events.*	*What affects one, affects us all.*
Subject Area	Humanities	Language A	Sciences	Mathematics	Language B
Unit Question	How do I know if I am really free?	What can I learn from conflict?	What if I could have my own "mini me"?	Could dinosaurs have survived?	How would I respond in an emergency?
Significant Concepts	*In a shrinking world, our identity could be threatened.*		*Sometimes you must break the rules in order to stand up for what you know is right.*		*We need to consider our own roots when making judgments about others.*
Subject Area	Humanities		Language A		Language B
Unit Question			What would it take for me to stand up for what I know is "right"?		What's on your mind?
Significant Concepts					*Things are never ideal when one side holds too much power.*
Subject Area					Humanities
Unit Question					Who's the boss?
Significant Concepts					*Logical reasoning is necessary to operate in today's world.*
Subject Area					Mathematics
Unit Question					What's the truth?

Student Learning Expectation: Reflection on ourselves and others—including issues such as relationships, sex and death

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*We need to be open to new ways of thinking.*	*Stereotypes keep us from seeing people for who they really are.*	*Leadership is critical to making real world transformation.*	*The whole is a sum of its parts.*	*Change is constant.*
Subject Area	Physical Education	Language A	Humanities	Music	Mathematics
Unit Question	How can I achieve a "birdie"?	Why do we judge books by their covers?	If you lead, do I have to follow?	How does a team of individuals work towards a shared vision?	What's great about gradient?
Significant Concepts		*When we understand others, we see their humanity.*	*We leave a unique imprint wherever we go.*	*Almost everything we do is social.*	
Subject Area		Language B	Humanities	Language B	
Unit Question		How are French teens like me?	How am I a product of my decade?	Where can I get the best French fries?	

Student Learning Expectation: Reflection on understanding ourselves— including issues such as personal management, self-esteem and growing up

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*Decisions are easier when you know your chances.*	*Our need to be informed is a universal connection.*	*Learning is not defined by a subject area.*	*Our backgrounds define us.*	*Every choice we make affects the outcome.*
Subject Area	Mathematics	Language B	Physical Education	Language B	Mathematics
Unit Question	How should I bet to win?	What's up in France?	How can I dance with the stars?	Who am I?	How do I solve the matrix?
Significant Concepts		*Balance in life is often a struggle.*			
Subject Area		Mathematics			
Unit Question		Do I focus too much on small tasks without looking at the bigger picture?			

Student Learning Expectation: Reflection on looking after ourselves—including issues such as personal hygiene, diseases and substance abuse

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts			*We rely on systems for survival.*		
Subject Area			Sciences		
Unit Question			How is my health like a game of dominoes?		

Student Learning Expectation: Making choices in terms of ourselves in the wider society—including behaviour and ethics

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*Following the rules creates a sense of predictability.*	*Good decisions today will impact future quality of life.*		*Risks can be taken within certain boundaries.*	*Actions speak louder than words.*
Subject Area	Physical Education	Physical Education		Music	Language A
Unit Question	How does it feel to get "six-packed"?	How can an apple a day keep the doctor away?		How can I push boundaries without breaking them?	What is being alive?

Student Learning Expectation: Making choices in terms of ourselves and others—including personal values and taking responsibility

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts		*Being great begins with the basics.*	*Knowing your own weaknesses can help you strategize for a positive outcome.*	*We make an imprint wherever we go!*	*Connecting with one another brings rewards and challenges.*
Subject Area		Physical Education	Physical Education	Sciences	Humanities
Unit Question		How can I play like Michael Jordan?	How can I ace this unit?	How do I make a mountain out of a molehill?	How is history and herstory our story, too?
Significant Concepts				*There are choices to make in handling influences in my life.*	
Subject Area				Language A	
Unit Question				How am I influenced by different perspectives?	
Significant Concepts				*The choices we make often affect us for the rest of our lives.*	
Subject Area				Language B	
Unit Question				What am I going to do?	

Student Learning Expectation: Making choices in terms of understanding ourselves—including self-control or needs and wants

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*In today's digital world, "stranded" has a new meaning.*	*Self-discipline leads to successful outcomes.*	*Fundamentals are always keys to success.*	*The ability to control empowers us.*	*We are only limited by ourselves.*
Subject Area	Technology	Physical Education	Physical Education	Physical Education	Music
Unit Question	How would I survive a year without my cell phone or iPod?	How can I be my own personal trainer?	How can I play better than Wayne Gretzky?	How do I get a kick out of challenges?	How can I push the limits without breaking them?

Student Learning Expectation: Making choices in terms of looking after ourselves—including diet and exercise

	Year 1	Year 2	Year 3	Year 4	Year 5
Significant Concepts	*Personal choices can have positive and negative effects on health.*	*Our current health is dictated by our own choices.*	*Our brain depends on many factors to operate to its potential.*	*The choices people make impact on their health.*	*We must think before we act.*
Subject Area	Language A	Language B	Physical Education	Language A	Physical Education
Unit Question	Why does spicy food make you hot?	Why am I a cheeseburger?	How does fitness figure in my life?	What makes me healthy?	What am I doing throwing things around?
Significant Concepts	*Our choices are ours alone to make.*			*What we eat says who we are.*	
Subject Area	Physical Education			Language B	
Unit Question	How can I avoid being a couch potato?			Why would anyone want to eat snails?	

Bloom's taxonomy	DP group 4 assessment objectives	DP group 4 command terms (summary)
Knowledge Comprehension	Assessment objective 1	Define
		List
		Label
		State
Application Analysis	Assessment objective 2	Apply
		Describe
		Distinguish
		Outline
Synthesis Evaluation	Assessment objective 3	Analyse
		Compare
		Deduce
		Discuss
		Evaluate
		Explain
		To what extent

Table 1
The relationship between IB Diploma Programme command terms and Bloom's taxonomy

Research underpinning the command terms

Benjamin S Bloom, an educational psychologist concerned with the reliability of assessment items and practices, developed a framework for classifying educational objectives according to their cognitive complexity. His work, which is commonly known as Bloom's taxonomy, consists of six categories of the cognitive domain. The categories identified in Bloom's taxonomy were: ***knowledge***, ***comprehension***, ***application***, ***analysis***, ***synthesis*** and ***evaluation***. The taxonomy provided definitions for each cognitive process in every category and sub-category. Bloom proposed that the categories were hierarchical and ranged from the simple and concrete thinking process (lower-order thinking skills) to more complex and abstract functions of thought (higher-order thinking skills).

Bloom's original taxonomy was published under the title *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain* (Bloom, Englehart, et al 1956).

Figure 1 shows a summary of Bloom's taxonomy categories for classifying objectives.

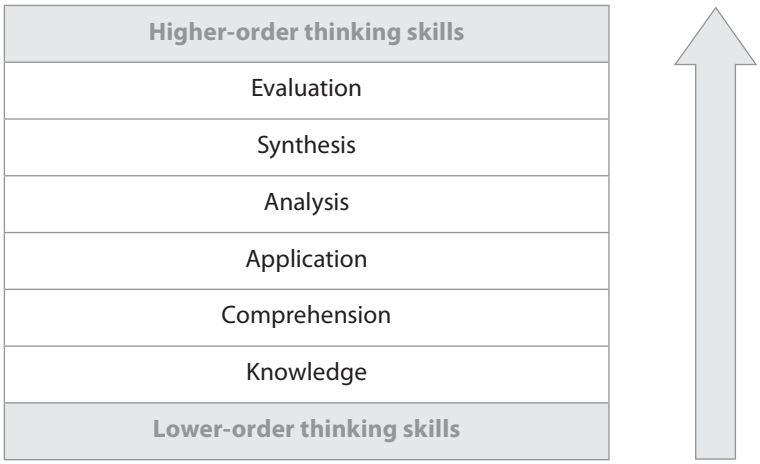


Figure 1
Bloom's taxonomy

IB assessment places an emphasis on the development of the "higher-order" cognitive skills (synthesis, reflection, evaluation and critical thinking) as well as more fundamental cognitive skills (knowledge, understanding and application). Understanding of and competency in the cognitive skills represented by the command terms supports the development of students as reflective thinkers. These are students who, in accordance with the *IB learner profile booklet* (2009), "exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions" and who would "give thoughtful consideration to their own learning and experience".

In the 50 years since its publication, the taxonomy has been subject to ongoing revisions (Anderson, Krathwohl, et al 2001) and criticisms (Marzano, Kendall 2007). However, the fundamental concept proposed by the taxonomy has been significant and influential in providing guidance for understanding, planning and developing educational objectives and assessment tools. Bloom's taxonomy, and the subsequent revised versions, offers a useful framework through which to express the diversity of the thinking skills required as part of teaching and learning.

It is worth considering similar concepts to Bloom's taxonomy that can influence the way in which schools look at the structures of learning. Säljö's (1979) and Bateson's (1972) work relates to levels of learning; whereas, both Bloom's and Biggs' (2003) work connects levels of understanding (addressing cognition and skills building) and are thus more directly relevant to the development of command terms.

Assessing the relevance of these similar concepts, revisions and the criticisms of Bloom's original taxonomy goes beyond the scope of this document. For those readers interested in these aspects the suggested reading list will provide a starting point.

Use of command terms in IB programmes

> What matters is not the absorption and regurgitation either of facts or of predigested interpretations of facts, but the development of powers of the mind or ways of thinking which can be applied to new situations and new presentations of facts as they arise.
>
> (Alec Peterson, first IB Director General, 2003: 47)

Command terms in the Diploma Programme

The phrase *command term* is used in the DP to refer to the words, generally verbs, specifically associated with the learning outcomes and assessment objectives of the programme. However, the use of the command terms is not exclusive to IB programmes. The thinking skills and cognitive processes represented by the command terms are an integral part of the daily communication that takes place between students and teachers during teaching and learning. Teachers use command terms when giving instructions, when questioning students, when posing problems and when eliciting responses from a class. Students are expected to understand and be able to respond effectively to the command terms present in teaching instructions, questions and problems presented to them.

Evidence of the use of command terms can be found in the objectives of the subject guides as well as in many examination questions in the DP. For example, students in the DP could be required to "**describe** the phenomenon of natural radioactive decay" or to "**discuss** the effectiveness of two strategies to reduce violence", or they could be asked to "**evaluate** the importance of Gandhi's leadership and methods in the struggle for Indian independence". To *describe*, to *discuss* and to *evaluate* are some examples from an extensive list of terms that the IB refers to as ***command terms***.

Students and teachers are expected to be confident using the command terms as part of teaching, learning and assessment. In an attempt to provide a working definition for the command terms, these could be defined as those *instructional terms that indicate the level of thinking and type of performance and/or behaviour that is required of students*.

Command terms in the Middle Years Programme

MYP subject guides make no explicit mention of the phrase "command term". However, the command terms are embedded in the objectives and assessment criteria of each subject area in the MYP. For example, in MYP sciences students are expected to "**apply** scientific knowledge and understanding to solve problems"; in MYP language A students "**compare** and **contrast** works, and connect themes across and within genres"; and in MYP arts students "**reflect** critically on their own artistic development and processes at different stages of their work".

The command terms and ATL

MYP approaches to learning (ATL) gives students the opportunity to develop a range of learning skills and strategies that will allow them to become more effective and reflective learners.

ATL skills areas include: **organization**, **collaboration**, **communication**, **information literacy**, **reflection**, **thinking** and **transfer skills**. Alongside the development of cognitive (thinking) skills, ATL promotes the development of **attitudes and dispositions** important for lifelong learning. It is through ATL that students are given the opportunity to reflect upon their own learning (metacognition), become aware of how they learn best, and consequently develop effective lifelong learning habits. Students are more likely to develop deeper conceptual understanding when they are aware of their own learning and can identify the type of thinking to draw upon in different contexts.

As teachers integrate ATL within subject content, they explicitly provide appropriate opportunities for the development of a range of learning skills and strategies, including those related to the use and application of the command terms. It is important that teachers make teaching and learning of command terms explicit to students when planning student learning expectations for ATL, as well as for other areas of interaction.

The outcome of using command terms is that students understand and know what to do when asked to "describe" as opposed to "discuss", or to "infer" as opposed to "explain". An understanding and mastery of the command terms is an ATL skill that can be applied in new situations across the MYP subject groups as well as in further courses, such as those of the DP.

Command terms across the continuum of IB programmes

In addition to supporting MYP teachers and coordinators, this document is helpful to DP teachers in understanding the skill development suggested by the command terms in the MYP. Likewise, the list of command terms illustrates students' skill development from the Primary Years Programme (PYP) to the MYP and then the DP.

Through their learning, over the course of the PYP, students acquire and apply a set of transdisciplinary skills: social skills, communication skills, thinking skills, research skills and self-management skills. These skills are valuable not only in the units of inquiry but also for any teaching and learning within the classroom and in life outside the school.

The thinking skills developed during the PYP can be demonstrated in many aspects of the MYP and DP, not least in the use of command terms. Command terms make thinking skills explicit by using them for questions in tests or essays; in formative and summative assessment; to help transfer interdisciplinary understandings; as part of an array of inclusive strategies; or as support for learners with differing language profiles.

The command terms in schools

> Teaching and learning are predominantly linguistics phenomena; that is we accomplish most of our learning through the vehicle of language … Therefore, language is a tool that teachers can use to enhance cognitive development. If we develop a successful programme for teaching thinking, we must also develop a language of cognition.
>
> (Costa, Marzano 2001: 379)

Below is a series of practical suggestions for schools in using command terms in teaching and learning.

Use precise terminology

Teaching and learning rely on the use of language. Therefore, it is important that teachers use precise terminology when explaining to students what is expected of them as part of an oral or written instruction. This point was stressed by Costa and Marzano (2001) who suggested that instead of asking students to "*Think what will happen if*" teachers should say "**Predict** what will happen if", or instead of saying "Look at these data" teachers should say "**Compare** these data". Other examples could include "Classify" instead of "Put into groups" or "Analyse" instead of "Let's work out this problem". Consistent and regular use of command terms across subject areas will help students to develop habits of mind, which will encourage the development of metacognitive awareness.

Make teaching and learning of command terms explicit

Schools should provide opportunities for the explicit explanation of command terms within the context of the subject groups. The teaching and learning of command terms should be embedded in the curriculum through ATL student learning expectations developed by schools.

By sharing command terms with students, teachers are able to give opportunities to practise relevant skills; to check understanding of the terms used to direct tasks; and to discuss what is expected or required, and the steps involved in completing tasks successfully. Each command term refers to specific thinking skills, practices and processes that constitute a subject or discipline, along with its content. In order to understand a discipline, which is a particular way of knowing, it is necessary to be fluent in the relevant command terms. The use of command terms overlaps between subject areas and should not be divided as being more or less applicable from one to another.

Ensure consistent use of command terms

The MYP command terms list presented in this document has been aligned with the command terms list used in the DP. Common or generic definitions have been provided for each command term. In some cases subject-specific clarifications have been included when a definition allows for subject-specific interpretation

(for example, "integrate"). It is important that both students and teachers share a common understanding of the command terms so that they can use them confidently and competently in teaching and learning. Teachers should use the command terms and their definitions in a consistent manner across the MYP and the DP.

Having a consistent definition of a command term enables those students with diverse learning needs to understand the meanings and their application across disciplines. This clarity of terminology allows these students to develop depth to their responses over time, which may reflect their true potential. Consistent application of command terms reduces stress and confusion about their meaning. Teachers can then focus on the specific skills of their discipline, which need to be taught in relation to the command terms of their subject area in order for students to successfully complete assessment tasks.

Schools are encouraged to make the command terms list available to both students and teachers to ensure that a common language and understanding of the command terms is developed within and across subject groups and programmes.

Support curriculum development and unit planning

The list of command term definitions aims to support teachers with the development of curriculum documents, including the formulation of student learning expectations for the areas of interaction, as well as the planning of individual units of work through the unit planning process. The use of command terms is instrumental during the process of developing interim objectives and interim assessment criteria.

Enable continuity in the development of thinking skills

While the definitions for the command terms remain the same, the expectation for the level of sophistication of students' understanding, responses and performances is expected to progress with students' maturity and development, and should correspond to the different stages of the MYP–DP educational continuum.

Opportunities to develop the thinking skills represented by the command terms should be sought out within and across the subject groups of the MYP. Collaborative planning should aim to support the transfer of thinking skills across different contexts and into new situations. Moreover, through vertical planning a developmental continuum of thinking skills could be planned to support students in their transition across programmes and to prepare them for success with their understanding of command terms in the DP. Figure 8 in *Making the PYP happen: A curriculum framework for international primary education* (December 2009) outlines the set of transdisciplinary skills that PYP students may acquire and apply. The thinking skills suggested include analysis, evaluation, metacognition and comprehension. These areas can be built upon and developed through the MYP.

Glossary of command terms in the MYP

The command terms listed are used to define the thinking skills that MYP students are expected to demonstrate. The definitions may vary when used in other contexts.

Command terms	MYP definitions
Analyse	Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.
Annotate	Add brief notes to a diagram or graph.
Apply	Use knowledge and understanding in response to a given situation or real circumstances.
Appraise	Evaluate, judge or consider text or a piece of work.

Command terms	MYP definitions
Argue	Challenge or debate an issue or idea with the purpose of persuading or committing someone else to a particular stance or action.
Calculate	Obtain a numerical answer showing the relevant stages in the working.
Classify	Arrange or order by class or category.
Comment	Give a judgment based on a given statement or result of a calculation.
Compare	Give an account of the similarities between two (or more) items or situations, referring to both (all) of them throughout.
Compare and contrast	Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.
Construct	Develop information in a diagrammatic or logical form.
Contrast	Give an account of the differences between two (or more) items or situations, referring to both (all) of them throughout.
Deduce	Reach a conclusion from the information given.
Define	Give the precise meaning of a word, phrase, concept or physical quantity.
Demonstrate	Prove or make clear by reasoning or evidence, illustrating with examples or practical application.
Derive	Manipulate a mathematical relationship to give a new equation or relationship.
Describe	Give a detailed account or picture of a situation, event, pattern or process.
Design	Produce a plan, simulation or model.
Determine	Obtain the only possible answer.
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Distinguish	Make clear the differences between two or more concepts or items.
Document	Credit sources of information used by referencing (or citing) following one recognized referencing system. References should be included in the text and also at the end of the piece of work in a reference list or bibliography.
Estimate	Find an approximate value for an unknown quantity.
Evaluate	Assess the implications and limitations; make judgments about the ideas, works, solutions or methods in relation to selected criteria.
Examine	Consider an argument or concept in a way that uncovers the assumptions and interrelationships of the issue.
Exemplify	Represent with an example.
Explain	Give a detailed account including reasons or causes.
Explore	Undertake a systematic process of discovery.

Command terms	MYP definitions
Formulate	Express precisely and systematically the relevant concept(s) or argument(s).
Identify	Provide an answer from a number of possibilities. Recognize and state briefly a distinguishing fact or feature.
Infer	Deduce; reason from premises to a conclusion. Listen or read beyond what has been literally expressed.
Interpret	Use knowledge and understanding to recognize trends and draw conclusions from given information.
Investigate	Observe, study, or make a detailed and systematic examination, in order to establish facts and reach new conclusions.
Justify	Give valid reasons or evidence to support an answer or conclusion.
Label	Add title, labels or brief explanation(s) to a diagram or graph.
List	Give a sequence of brief answers with no explanation.
Measure	Find the value for a quantity.
Outline	Give a brief account.
Predict	Give an expected result of an upcoming action or event.
Present	Offer for display, observation, examination or consideration.
Prove	Use a sequence of logical steps to obtain the required result in a formal way.
Recall	Remember or recognize from prior learning experiences.
Reflect	Think about deeply; consider.
Recognize	Identify through patterns or features.
Show	Give the steps in a calculation or derivation.
Sketch	Represent by means of a diagram or graph (labelled as appropriate). The sketch should give a general idea of the required shape or relationship, and should include relevant features.
Solve	Obtain the answer(s) using appropriate methods.
State	Give a specific name, value or other brief answer without explanation or calculation.
Suggest	Propose a solution, hypothesis or other possible answer.
Summarize	Abstract a general theme or major point(s).
Synthesize	Combine different ideas in order to create new understanding.
Use	Apply knowledge or rules to put theory into practice.